Ontario Geological Survey
Report 237

Geology of the

Firstbrook and Parts of Surrounding Townships Area

District of Timiskaming

by
G.W. Johns

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FOREWORD

FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS AREA

Detailed geological mapping of Firstbrook Township and parts of the surrounding townships was undertaken by the Ontario Geological Survey, Ontario Ministry of Natural Resources, on behalf of the Ontario Ministry of Northern Affairs. This mapping programme was designed to encourage exploration and prospecting interest and to provide a mineral potential evaluation and planning base for an area that had never before been mapped in detail.

The Cobalt mining area and its rich silver and cobalt mineralization is located near to the eastern boundary of the report area. Similar geologic settings for this silver-cobalt mineralization were mapped within the report area. Potential for strataform base-metal deposits and massive volcanogenic base-metal deposits are discussed in this report.

V.G. Milne
Director
Ontario Geological Survey

CONTENTS

PAGE

Abstract ix
Introduction 1
Location 1
Access 1
Topography and Drainage 2
Previous Geological Investigations 2
Present Geological Survey 3
Acknowledgments 3
Mineral Exploration 3

General Geology 4
Table of Lithologic Units 5
Early Precambrian 6
Metavolcanics and Metasediments 6
Felsic Metavolcanics 6
Metasediments 7
Mafic Intrusive Rocks 7
Middle Precambrian 11
Huronian Supergroup 11
Cobalt Group 11
Gowganda Formation 11
Coleman Member 11
Pebbly Wacke 12
Argillite 13
Conglomerate 14
Arkose 15
Wacke 16
Metamorphosed Coleman Member Rocks 16
Firstbrook Member 17
Lorrain Formation 21
Depositional Environments of Huronian Rocks 23
Mafic Intrusive Rocks 25
Nipissing Diabase 25
Late Precambrian 30
Mafic Intrusive Rocks 30
Major Aeromagnetic Anomaly 32
Cenozoic 32
Quaternary 32
Pleistocene and Recent 32

Structural Geology 33
Folds 34
Faults 34

Economic Geology 35
Gold 36
Silver and Cobalt 36
Base Metals 39
Description of Properties 40
Agnico-Eagle Mines Limited [Dotsee Mine] (1) 43
Dotsee Mine 43
Canadian Prospect (Cobalt-Kittson Mine) (2) 45
Colebucke Mines Limited [1949] (3) 46
Colebucke Mines Limited [1949] (4) 46
Colebucke Mines Limited [1949] (5) 46
Harmon Occurrence (6) 47
LaPierre, A., Occurrence (7) 47
McKinnon Mine (8) 48
Old Colony Securities Limited [1960] (9) 49
Sapphire Petroleums Limited (10) 49

Seed Occurrence (11) 49
Silverbucke Mines Limited [1949] (12) 50
Walters, L.E. [1948] (13) 50
Recommendations for Exploration 50

References 53
Index 57

TABLES

1–Table of Lithologic Units 5

2–Felsic metavolcanic chemistry 10

3–Nipissing Diabase chemistry 29

4–Location of samples 30

5–Keweenawan Diabase chemistry 31

6–Patented claim taxpayers 37

7–Assay results 38

8–Assessment work available 41

FIGURES

1–Location map viii

2–Jensen Cation Plot 8

3–AFM plot 9

4–Ternary plot for sediments 26

5–Plan and cross section of property of Agnico-Eagle Mines Limited (Dotsee Mine) 42

PHOTOGRAPHS

1–Pebbly wacke 12

2–Soft sediment deformation 14

3–Chlorite spotting 16

4–Basal Firstbrook Member argillite 18

5–Firstbrook Member wacke 19

6–Fault induced deformation 20

7–Contact between Gowganda and Lorrain Formations 21

8–Ball and pillow structures 23

9–Lorrain Formation arkose 24

10–Altering feldspars 24

11–Chilled diabase 27

12–Boulder terrace 33

GEOLOGICAL MAP

(back pocket)

Map 2474 (coloured)–Firstbrook and Parts of Surrounding Townships, District of Timiskaming.

Scale 1:31 680 (1 inch to ½ mile).

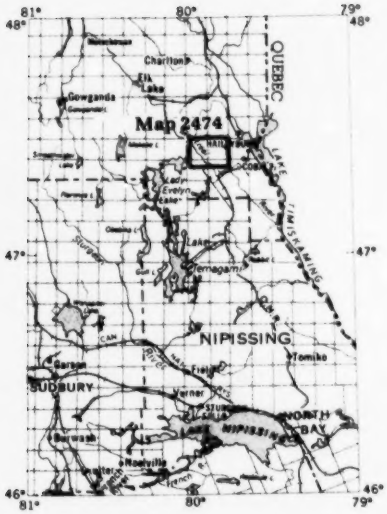

Figure 1–Key map showing location of the Firstbrook and surrounding townships area. Scale 1:3 168 000 or 1 inch to 50 miles.

ABSTRACT

This report describes the geology of Firstbrook Township and parts of the surrounding townships area, the centre of which is 18 km west of Haileybury in the District of Timiskaming.

The area is mainly underlain by the Middle Precambrian Gowganda and Lorrain Formations of the Cobalt Group of the Huronian Supergroup. The Gowganda Formation unconformably overlies Early Precambrian metavolcanics and metasediments which occur as small inliers within the area. Both the Huronian and Archean rocks are intruded by Middle Precambrian Nipissing Diabase sills and Late Precambrian (Keweenawan) Diabase dikes.

The Early Precambrian is exposed in two small inliers within the Gowganda Formation. The felsic metavolcanic inlier consists of tuff, lapilli-tuff, tuff breccia, flows, and conglomerate consisting of volcanic clasts. The metasedimentary inlier consists of conglomerate.

The Gowganda Formation is divided into a lower Coleman Member and an upper Firstbrook Member. The Coleman Member consists of thick massive pebbly wacke, argillite, conglomerate, arkose, and wacke. The Firstbrook Member conformably overlies the Coleman Member. The lower part of the Firstbrook Member is thinly laminated, black to grey argillite. Gradational with this is thickly laminated red siltstone, brownish red shaley siltstone, and dark green discontinuous beds of chloritic siltstone. Continuing up section, the siltstone is gradually replaced by fine-grained red wacke beds which increase in thickness and number. The top of the Firstbrook Member consists of very thin to thin beds of red wacke with minor siltstones. Ripple marks and crossbeds are common.

The Lorrain Formation lies conformably on, and has a sharp contact with the Gowganda Formation. The contact between the Gowganda Formation and Lorrain Formation as defined in this map area coincides with the appearance of thickly bedded red wackes. The Lorrain Formation consists of a basal red wacke grading rapidly up into grey to grey-green fine-grained arkose.

Nipissing Diabase intrudes both the Middle and Early Precambrian rocks as an undulatory sill and as vertical dikes. Hypersthene quartz diabase grades into a mesocratic varied-textured diabase and a granophyric upper zone. Pegmatite and pure granophyre occur throughout the upper part of the sills. Late Precambrian (Keweenawan) Diabase occurs as narrow dikes cutting all older rock types.

The youngest structural features in the map area are the northwest-trending faults associated with the Timiskaming Rift Valley. The older faults trend northeasterly to easterly. A low angle thrust fault containing thick sheets of quartz was noted south of McLennon Lake. Folding is confined to soft sediment deformation and supratenuous folds.

The map area has been intensively prospected for silver and cobalt. Mine development was carried out on 3 properties; one produced some cobalt. There is a possibility for stratabound base-metal mineralization in the Gowganda Formation.

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If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE–Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

Geology of the

Firstbrook and Parts of Surrounding Townships Area

District of Timiskaming

By

G.W. Johns[1]

INTRODUCTION

Location

The Firstbrook and parts of surrounding townships area consist of 259 km^2 and is located west of Haileybury and Cobalt in the District of Timiskaming. The area examined is bounded by Latitudes 47°22′30″N and 47°30′00″N, and Longitudes 79°45′W and 80°00′W, and comprises Firstbrook Township, most of Barr Township, and parts of Lundy, Hudson, Dymond, Bucke, Coleman, and Kittson Townships. The centre of the map area is 18 km west of Haileybury, and is located within the Sudbury Mining Division.

Access

Highways 11 and 11B cross the southeastern corner of the map area. Highway 558 (Haileybury west road) is an all-weather gravel road extending east-west across the northern third of the map area, and provides access to the public dock at Mowat Landing on the Montreal River. A Ministry of Natural Resources all-weather public access road loops south and east from the western end of Highway 558 through the western third and southern third of the area and joins the Loon Lake road which connects Highway 11 with Portage Bay on the Montreal River. An all-weather cottage road to Bartle Lake connects High-

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way 558 and 65 [north of the map area]. Hudson and Dymond Township roads provide access to the northeastern corner of the map area. An all-weather road separates Firstbrook and Bucke Townships south of Highway 558. The Trans-Canada Natural Gas Pipeline is located along the eastern edge of the map area.

Access to the area west of the Montreal River can be gained by boat from either the Montreal River or the Lady Evelyn River. A portage is provided around the Mattawapika Dam near the mouth of the Lady Evelyn River.

Many new and old logging roads are located in the central part of the map area. A fire line surrounding a 30 000 acre fire, which burned southeastern Barr and south-central Firstbrook Townships in 1977, may be walked on or used as a winter road.

Topography and Drainage

Topography in the map area is controlled directly by the nature of the geology. For example, northeast of Mowat Landing, the Coleman Member of the Gowganda Formation forms steep-sided, fault-bounded, northeast-trending ridges and hills with a maximum elevation of 364 m above sea level. The relatively flat-lying Firstbrook Member of the Gowganda Formation has very little topographic expression, and varies from elevations of 333 m above sea level in the west to 260 m above sea level in the east, and 315 m is the average elevation. Steep-sided hills of resistant Lorrain Formation in the southwestern corner of the map area form the highest point in the map area at 394 m above sea level. The Nipissing Diabase sills around Pike Lake, McLaren Lake, and northeastern Firstbrook Township form steep-sided hills. The highest elevation attained by these diabase hills, at a location south of McLaren Lake, is 379 m above sea level.

The central part of the map area is covered with sandy boulder till, and swampy conditions are common. The flood plain of the Montreal River is of variable width and the ease of traversing across it depends on the level of the Montreal River which fluctuates substantially with the amount of discharge over the Mattawapika Dam and other control dams downstream. The more rugged parts of the map area are well drained; the western part drains into the Montreal River System and the northern and eastern parts drain into several small streams. All drainage eventually is into Lake Timiskaming.

Northeast of the Cross Lake Fault, the map area consists of the cleared farm lands of the Little Clay Belt. Gently rolling, well-drained glacial outwash stretches from Pike-Spring Lakes to Loon Lake, and the area around Moose Lake and Highway 558 has been cleared for farming.

Previous Geological Investigations

Although most of the surrounding areas have been mapped previously, the map area had not been examined in whole prior to the current survey. In 1922, the Blanche River area, which is adjacent to the map area's northern boundary, was mapped and then reported on by Burrows and Hopkins (1922). Thomson

(1956, 1964) mapped Bucke Township and completed a description of all the mining properties in it. The silver area around Cobalt has been mapped in detail by Thomson (1963a, 1963b, and 1963c). In 1969, Card *et al.* (1973) completed a reconnaissance survey of the Maple Mountain area west of, and adjacent to the current map area. Lovell and Caine (1970) defined the Lake Timiskaming Rift Valley. Lovell and Frey (1976) mapped, in 1970, an area which included the townships of Hudson and Dymond.

Present Geological Survey

Field work for this report was undertaken between May 23 and August 23, 1979. The crew consisted of the author, 1 senior assistant, and 3 junior assistants.

Mapping was done using air photographs having a scale of 1 inch to ¼ mile (1:15 840), which were taken in 1970 and 1977 and were provided by the Air Photo Library, Ontario Ministry of Natural Resources. Outcrops were reached and examined using pace and compass methods of traversing and the outcrop geology and boundaries of outcrop areas were plotted in the field on acetate overlays to the air photographs. The data were transferred to a cronaflex base map prepared by the Cartography Section, Surveys and Mapping Branch, Lands and Waters Group, Ontario Ministry of Natural Resources, at a scale of 1 inch to ¼ mile (1:15 840). The base map was prepared from Forest Resources Inventory maps (scale 1 inch to ¼ mile or 1:15 840) of the Timber Branch of the Ontario Ministry of Natural Resources. The geology is not tied to surveyed lines.

Acknowledgments

The author was assisted in the field by D.J. Good, T.D. Tennent, Robin Van Steenburgh, and R.R. Wolf. Robin Van Steenburgh, in her capacity as senior assistant, was responsible for mapping approximately 50% of the area.

The help and cooperation of the staff of the Ontario Ministry of Natural Resources in Temagami is gratefully acknowledged. The information obtained by the author from Brian Thorniley, Chief Geologist, Agnico Eagle Mines Limited was very helpful and is appreciated. The author is indebted to John Wood, Chief Geologist, Ontario Geological Survey, for his advice in the field, and discussions held with him during preparation of the report.

Mineral Exploration

The discovery of silver in 1903 in Cobalt, 5 km east of the eastern map boundary, prompted much regional prospecting and many undocumented pits and trenches within the map area resulted from this activity. Although no eco-

nomic deposits were discovered, several properties underwent underground development. The Cobalt-Kittson Mine (2)[1] on Kitt Creek, Kittson Township was worked from 1927 to 1930 with the development of a 776-foot shaft with attendant drifting on the 250-foot, 450-foot, and 598-foot levels (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In lot 1, concession V, Bucke Township, McKinnon Mines Limited (8) sunk a 150-foot shaft on quartz-carbonate veins in the Sharp Lake Diabase dike (Thomson 1964). On the northwestern quarter of the southern half of lot 1, concession II, Bucke Township, the Dotsee Mine (Seed Mine) (1) was discovered in 1906 and development commenced in 1909 with the sinking of a shaft to a depth of 210 feet. The mine was worked intermittently until 1939 with development on the 46-foot, 125-foot, 156-foot, and 207-foot levels (Thomson 1964). Agnico-Eagle Mines Limited currently own this property.

Exploration within the map area has been, for the most part, oriented towards the discovery of silver-cobalt mineralization. As such, this work was concentrated along the lower contact of the Nipissing Diabase sill and dike in the northern part of Coleman Township and the southern part of Firstbrook Township, the Nipissing Diabase east-southeast of Moose Lake and north of Highway 558 in eastern Firstbrook and Bucke Townships, and the Keweenawan Sharp Lake Diabase dike and its surrounding sediments.

In 1948 and 1949, Colebucke Mines Limited undertook geological and magnetometer surveys on property held in the northwestern part of Bucke Township and the southeastern part of Firstbrook Township. The Walters claim group, located north of Maggie Lake, was geolcgically surveyed in 1948. In 1952, Harmon Oils and Minerals Limited sunk 8 diamond-drill holes having a total length of 1789 feet in the Nipissing Diabase dike at Charlotte Lake in south-central Firstbrook Township. Sapphire Petroleums Limited completed a geological survey in 1957 to cover the Nipissing Diabase and Lorrain Formation south of George and Charlotte Lakes. Further geology and magnetometer work was carried out in lot 1 of concessions III, IV, V of Bucke Township during 1960 by Old Colony Securities Limited and during 1963 by Norite Explorations Limited. Norite Explorations Limited also drilled 5 diamond-drill holes through the Sharp Lake Diabase dike for a total length of 3142 feet (Assessment Files Research Office, Ontario Geological Survey, Toronto).

The recent discovery of a 0.5 km^2 Archean felsic metavolcanic inlier south of Maggie Lake prompted Copperfields Mining Corporation Limited and Pickle Crow Explorations Limited to check for base metals by carrying out a geological, magnetometer, electromagnetic, and self potential survey in 1972 (Assessment Files Research Office, Ontario Geological Survey, Toronto).

GENERAL GEOLOGY

The map area lies wholly within the Cobalt Embayment of the Southern Structural Province of the Canadian Shield (Card *et al.* 1972). Middle Precambrian Huronian sediments of the Cobalt Group unconformably overlie Early

[1]Number in parentheses refers to property number listed on Map 2474, in back pocket.

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glacial, glaciofluvial, swamp, lake, and stream deposits.

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

Diabase, epidotized diabase, granophyric diabase.

Intrusive Contact

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

NIPISSING DIABASE

Quartz diabase, granophyric diabase, granophyre, varied textured diabase, diabase chilled margins, porphyritic diabase.

Intrusive Contact

HURONIAN SUPERGROUP

COBALT GROUP

LORRAIN FORMATION

Arkose, quartz arenite, basal maroon wacke, metamorphosed arenites.

Conformable Contact

GOWGANDA FORMATION

FIRSTBROOK MEMBER

Black to grey shaley argillite, red siltstone and shale, red wacke and siltstone, metamorphosed sediments.

Conformable Contact

COLEMAN MEMBER

Pebbly wacke, argillite, conglomerate, wacke, arkose, metamorphosed sediments.

Unconformity

EARLY PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

Lamprophyre.

Intrusive Contact

METASEDIMENTS

Conglomerate.

METAVOLCANICS

FELSIC METAVOLCANICS

Massive flows, hornblende porphyry, tuffs, lapilli-tuffs, tuff-breccia.

Precambrian metavolcanics and metasediments. Both the Middle and Early Precambrian rocks have been intruded by Nipissing Diabase sills and dikes dated at 2150 Ma (Van Schmus 1965; Fairbairn *et al.* 1969). Late Precambrian (Thomson 1956) diabase dikes are the youngest rocks found.

The Cobalt Group of sediments within the map area consist of the Gowganda Formation, dated at 2288 Ma (Fairbairn *et al.* 1969) and the Lorrain Formation. The Gowganda Formation in the vicinity of Cobalt can be subdivided into an upper and lower member, these are called formations by Thomson (1957). The lower member, the Coleman Member consists of pebbly wacke, argillite, arkose, and conglomerate. The upper member, the Firstbrook Member consists of black and grey argillite, red argillite and siltstone, and red siltstone and wacke. Robertson *et al.*(1969) suggested that the name Gowganda Formation be retained for these 2 subdivisions.

The Nipissing Diabase within the map area is believed by the author to belong to 1 continuous undulating sill-like body with an approximate thickness of 300 m. Card and Lumbers (1977) and Pyke *et al.* (1973) indicated that this undulating sill extends to the north and east of the map area.

The Huronian sedimentary rocks are gently dipping to flat lying. Folding is perceived to be supratenuous and to be a reflection of the underlying Early Precambrian topography rather than the result of tectonic deformation. Faulting, though not extensive, has disrupted the stratigraphy to some extent.

Early Precambrian (Archean)

METAVOLCANICS AND METASEDIMENTS

Felsic Metavolcanics

The felsic metavolcanics are exposed as a 0.5 km^2 inlier within the Firstbrook Member of the Gowganda Formation immediately south of Maggie Lake in southern Firstbrook Township. The felsic metavolcanics consist of lapilli-tuff, tuff-breccia, tuff, massive or porphyritic flows, and conglomerate. The lithologies appear to strike north-northwest. Hornblende porphyry forms the eastern contact of the conglomerate; rounded clasts of hornblende porphyry occur within the conglomerate, thereby suggesting that the stratigraphic top direction is to the west.

The metavolcanics are massive or thickly bedded with a white weathered surface and a light green fresh surface. The classification of the pyroclastic rocks was based on the ternary plot of Fisher (1966, p.292).

The lapilli-tuff contains lithic clasts, feldspar crystals, crystal fragments, and has a cryptocrystalline groundmass. It is unsorted, and crystals ranging up to 1.6 mm, and lithic clasts ranging up to 3.5 mm in maximum dimension, are supported by the cryptocrystalline quartzofeldspathic groundmass. The most common lithic fragments in the lapilli-tuffs are crystal tuffs which are themselves extremely similar to the matrix material of the lapilli-tuff. Minor clasts of metavolcanics of more mafic composition also occur. The albite-oligoclase

plagioclase feldspars and the quartzofeldspathic groundmass are partly altered to sericite.

The felsic tuffs vary from fine-grained crystal tuffs to coarse-grained lithic-crystal tuffs. Some rounding of the lithic clasts occurs in some beds. The lithic clasts are of coarse tuff size and are similar to the crystal tuff clasts found in the lapilli-tuff. The cryptocrystalline groundmass is partly altered to epidote, but the clasts are generally unaltered or are slightly sericitized. The crystal tuffs are generally unsorted with feldspar crystals and crystal fragments being supported by a cryptocrystalline quartzofeldspathic groundmass.

Massive felsic flows are uncommon and have a weathered appearance, similar to the tuffs. The flows are very fine grained and dense.

Tuff-breccia consists of subrounded to subangular tuff clasts and minor subrounded mafic metavolcanic clasts set in a tuffaceous matrix. The rock exhibits a foliation, is clast-supported, and is essentially monolithologic.

A whole rock analysis of a sample of the felsic tuff indicates that these metavolcanics have a calc-alkalic rhyolitic composition. Figures 2 and 3 show the relative location of this sample on a cation plot and on AFM plot. Table 2 gives the chemical analysis and normative mineralogy of the sample.

Metasediments

Early Precambrian metasediments are found in an Archean inlier in the southeastern corner of Hudson Township and interbedded with the felsic metavolcanics in Firstbrook Township. Only the southernmost tip of the metasedimentary inlier is found within the map area. Lovell and Frey (1976) have mapped and classified these metasediments as "Timiskaming type". Where seen by the author, the metasediments are rusty, foliated, polymictic, jasper-bearing, matrix-supported conglomerates. The rust is caused by the presence of 3 to 4% euhedral pyrite cubes and minor chalcopyrite.

Conglomerate composed of predominantly volcanic fragments occurs interbedded with the metavolcanics. It is a clast-supported coarse pebble to cobble conglomerate with a feldspathic matrix. The clast population consists predominantly of felsic tuff and hornblende porphyry, with the occasional mafic metavolcanic clast. Clast size grades into a finer pebble conglomerate along and across strike. Immediately underlying the conglomerate is a grey hornblende porphyry with an aphanitic groundmass and minor xenoliths. The hornblende phenocrysts are about 1 mm long.

MAFIC INTRUSIVE ROCKS

A lamprophyre dike cuts the Early Precambrian felsic metavolcanic assemblage south of Maggie Lake. Lovell and Frey (1976) also mapped similar dikes in the metasedimentary inlier in Hudson Township. The lamprophyre is fine grained, weathers to a brown colour, and has a dark green fresh surface. The rock is highly altered with original hornblende phenocrysts, now com-

Firstbrook Area

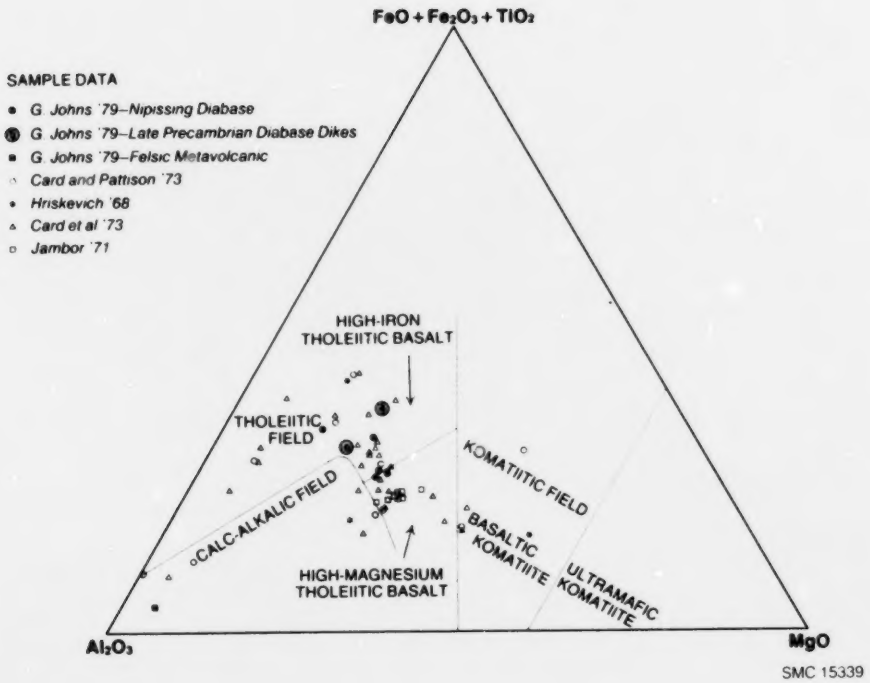


Figure 2–Jensen Cation Plot of Nipissing Diabase sills, Keweenawan Diabase dikes, and felsic metavolcanics.

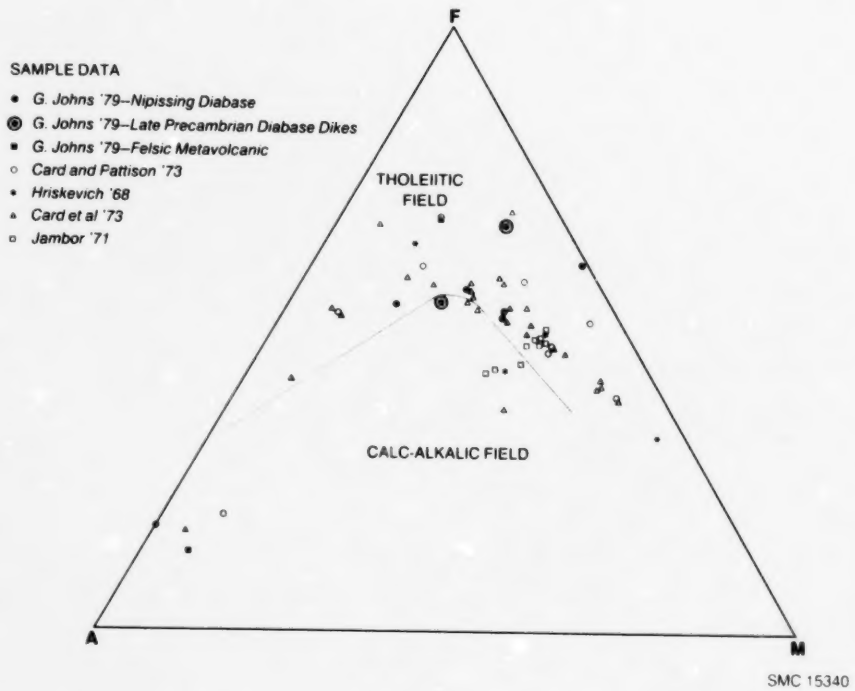


Figure 3–AFM plot of Nipissing Diabase sills, Keweenawan Diabase dikes, and felsic metavolcanics.

TABLE 2 CHEMICAL ANALYSIS OF A FELSIC METAVOLCANIC TUFF FROM THE EARLY PRECAMBRIAN INLIER SOUTH OF MAGGIE LAKE, FIRSTBROOK AND SURROUNDING TOWNSHIPS AREA

Sample Number	79-15 070
Irvine & Baragar Rock Name	calc-alkalic volcanic rhyolite
SiO_2	69.50
Al_2O_3	18.10
Fe_2O_3*	1.37
MgO	0.63
CaO	2.17
Na_2O	6.49
K_2O	1.05
TiO_2	0.17
P_2O_5	0.06
MnO	0.02
CO_2+	0.25
S+	0.01
L.O.I.#	0.90
Total	99.82
S.G.	2.65
	CIPW Norms
AP	0.1
OR	6.2
AB	55.2
AN	10.4
C	2.5
HM	1.4
EN	1.6
FS	0.0
Q	22.4
RU	0.2

Footnotes

* Fe_2O_3 as total iron
\+ Included as L.O.I.
\# Loss on ignition

Analysis by the Geoscience Laboratory, Ontario Geological Survey

pletely altered to chlorite, in a very fine grained oligoclase-albite, carbonate, chlorite groundmass.

Middle Precambrian

HURONIAN SUPERGROUP

Cobalt Group

GOWGANDA FORMATION

The Gowganda Formation is the basal formation of the Cobalt Group, the youngest group in the Huronian Supergroup. The Gowganda Formation is exposed from Sault Ste. Marie to the Cobalt area and in most places can be subdivided into a lower and upper part (Thomson 1957; Lindsey 1969; Card *et al.* 1973; Wood 1973; Siemiatkowska 1978). In the Cobalt area, the lower part is referred to as the Coleman Member and the upper part is referred to as the Firstbrook Member.

Thomson (1957) stated that the Coleman Member in the vicinity of Cobalt has a maximum thickness of 500 feet and he also hypothesized that it might reach a maximum thickness of 1000 feet south of Cobalt. The Firstbrook Member is approximately 360 m thick in the immediate vicinity of the Dotsee Mine in Bucke Township (1979 personal communication, Brian Thorniley, Geologist, Agnico Eagle Mines Limited, Cobalt, Ontario). The author estimates a 485 m thickness for the Firstbrook Member southwest of Malcolm Lake in Firstbrook Township.

Coleman Member

Coleman Member rocks are found:

1. in the northwestern part of the map area between Mowat Landing and Pike Lake
2. in the northeastern corner of the map area, above and below the Nipissing Diabase sill
3. above the Nipissing Diabase sill around Portage Bay
4. as erosional remnants on the Archean felsic metavolcanic inlier

The Coleman Member is a heterogeneous assemblage of pebbly wacke, argillite, conglomerate, arkose, and wacke, and is characterized by rapid facies change over short distances. The 2 most common lithologies are pebbly wacke and argillite. The pebbly wacke and argillite occur in thick successions which also contain the other lithologies interbedded within them.

OGS 10 632

Photo 1–Coleman Member pebbly wacke on the shore of Le Moyne Lake.

PEBBLY WACKE

Pebbly wackes are massive wackes containing 2 to 15% clasts greater than 2 mm in size. This lithologic type is the most voluminous of all the Coleman Member sediments. It weathers brown and has a greenish grey to dark grey fresh surface. It is unsorted, unbedded to thickly bedded, and generally massive. The matrix has a fine-grained sandy texture and is unsorted. Diagnostic of the Coleman Member is the presence, in the matrix, of angular quartz grains usually 1 mm or less in size. The percentage of the subrounded to subangular pebbles varies between the 2 and 15% end members. Clasts are generally in the 4 to 64 mm size range with some as low as 2 mm and some greater than 256 mm. White granitic clasts are the most common, with felsic and mafic

metavolcanic and gneissic clasts also being present. Minor sulphide clasts or altered sulphide clasts are also found within the pebbly wackes. Photo 1 is an example of a pebbly wacke cut by quartz veins.

Thin section examination of the pebbly wacke reveals a disrupted framework of angular to subangular grains in a clay size matrix of chlorite and sericite. Sand size grains consist of quartz, feldspar, epidote, and lithic clasts. Quartz and feldspar are present in a ratio of 2 to 1. Potassic feldspar is more common than the plagioclase feldspar and both are partly altered to sericite. Lithic clasts consist of metavolcanics, metasediments, and what appears to be deformed pieces of Huronian sediment. Within the clayey matrix muscovite laths, opaque minerals, and epidote clots are common.

ARGILLITE

Argillite, as referred to in this report, is a low metamorphic rank mudstone and siltstone with very little fissility. Coleman Member argillites are found both in thick monotonous sequences and as thin interbeds within the other lithologic types. West of Le Moyne Lake, a succession of argillites underlies the heterolithologic sequences of the Coleman Member. Around and to the west of Blanche Lake, argillites overlie that same heterolithologic sequence. South of Le Moyne Lake, argillites immediately underlie rocks of the Firstbrook Member.

The argillites range in colour from grey to greenish grey, green, and reddish brown; grey and greenish grey are the most common colours. Weathered surfaces are brown to grey with the more siliceous argillites weathering light grey. The bedding thicknesses vary from finely laminated to massive. Most commonly, the argillites are thickly laminated with occasional very thin, graded beds. Bedding is continuous on the outcrop scale except for minor discontinuous chlorite beds.

Graded beds are found locally. "Dropstones" ranging in size from fine sand to boulders are commonly found throughout the argillites. The smaller "dropstones" show no disruption of the underlying bedding, while the pebble to cobble size ones do produce impact features in the underlying beds. In one locality, a "dropstone" resting on a massive wacke bed is draped by argillite laminae. A wormy textured argillite containing microfaults and microbrecciated zones is found along the western shore of Le Moyne Lake. The wormy texture is caused by discontinuous, irregular, dark, very fine grained beds in a more massive appearing greenish grey argillite.

Thin section examination revealed that most argillites are finely laminated silty mudstones. Fine to medium silt sized angular to sub-angular quartz and epidote grains float in a clay size matrix composed of chlorite, sericite, quartz, and feldspar. Grains of coarse silt and very fine sand are found between laminae and do not disrupt bedding. Patches of carbonate are restricted to the silt-rich laminae. Other silt size clasts found within the silty argillite consist of hornblende, muscovite, chlorite, and rock fragments.

Laminae are continuous and linear across the thin sections except for some chlorite-rich laminae which are discontinuous. Soft-sediment deformation, pos-

OGS 10 633

Photo 2–Photomicrograph of Coleman Member siltstone, silty mudstone and grit showing tectonic deformation of unconsolidated sediments.

sibly caused by tectonic activity while the rock was still unconsolidated, caused the features visible in Photo 2.

CONGLOMERATE

Conglomerate occurs at all stratigraphic levels within the Coleman Member. The thick, massive conglomerate beds are not extensive and are not commonly traceable between outcrops. For the most part, they are unsorted, heterolithologic, matrix supported, pebble conglomerates with a wacke matrix. These rocks are similar to the pebbly wackes in appearance except the volume of framework clasts ranges between 15 and 60% with the majority of the conglomerates having between 25 and 30% framework clasts. Some conglomerates have an argillaceous matrix or uncommonly, an arenaceous matrix. Lithic clasts range in size from less than 2 mm to 256 mm and consist of granitic rocks, gneisses, mafic and felsic metavolcanics, quartz, and chert. Clasts are subangular to subrounded with the larger clasts usually being granitic and more rounded.

Clast-supported conglomerate occurs along the township line west of Le Moyne Lake where it is interbedded with argillites, arenites, and poorly sorted matrix supported conglomerates. This conglomerate is poorly sorted and has an

arenaceous matrix. Clast size ranges from less than 1 mm to 80 cm with an average size of 2 to 10 cm.

A large flat-lying outcrop of massive, nonbedded, clast-supported and matrix-supported conglomerate occurs in the northeastern corner of the map area in Hudson Township. This conglomerate is unsorted, with a wacke matrix, and has 40 to 70% clasts. Unique to this exposure is the presence of approximately 10% clasts of subangular red and dark grey jasper magnetite iron formation. Beds of conglomerate interbedded with arkosic arenite are exposed just west of the Cross Lake Fault in Hudson Township.

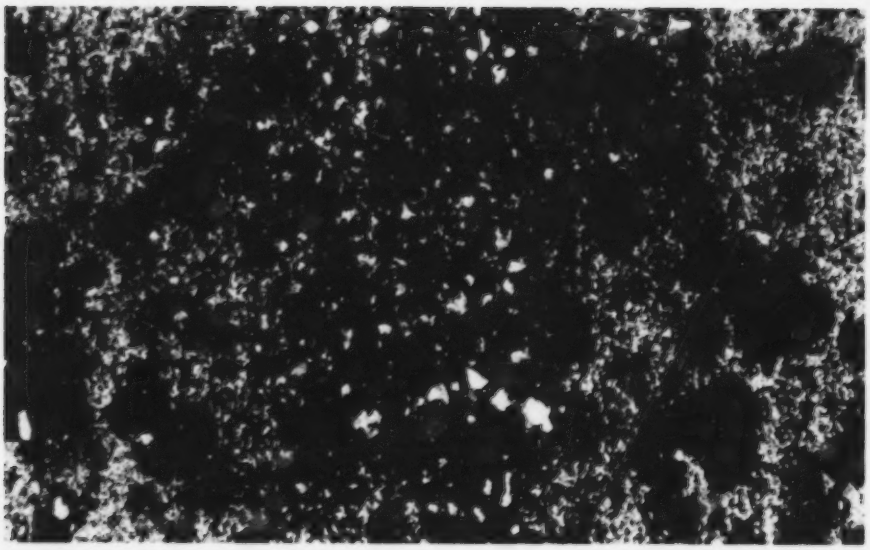
Thin, isolated, patches of unsorted Coleman Member conglomerate lie unconformably on the Archean felsic metavolcanic inlier located south of Maggie Lake in south-central Firstbrook Township. It is clast-supported and the clasts range in size from sand to cobble size. The subrounded clasts are composed of gneiss, felsic metavolcanics, and conglomerate composed of volcanic fragments. Two to 4% of these clasts appear to be locally derived from the underlying Archean conglomerate. Remnants of black, basal Firstbrook Member argillite can be seen lying between the clasts of the conglomerate. This type of Coleman Member conglomerate lying directly on the Archean basement has been classed as lodgement till by Wood (1975).

ARKOSE

Arkose is found throughout the Coleman Member as interbeds with the pebbly wacke and conglomerate. Around Mowat Landing, on both sides of the Montreal River, it appears to directly underlie the Firstbrook Member. South-southwest of Le Moyne Lake, it forms an apparent lens 212 m north of the contact with the Firstbrook Member and underlies Coleman Member argillite. Above the Nipissing Diabase sill east of Spring Lake in Hudson Township, metamorphosed arkose is found interbedded with meta-argillite.

The weathered surface is brown to pinkish buff and the fresh surface is generally greyish green to light grey with minor sandy pink arkose found west of Le Moyne Lake. It is well sorted, very fine to fine sand sized and consists of subangular to subrounded feldspar and quartz grains with minor detrital epidote, muscovite, chlorite, rock fragments, and opaque grains. It is generally clast-supported with very little matrix. Bedding is generally thick and massive, but in some cases, gradation into siltstone is seen. East of Spring Lake, angular argillite chips are seen along bedding planes and complete argillite beds also occur. Load casts are present at the base of some of these arkose beds.

In the Coleman Member arkoses, potassic feldspar exceeds the amount of plagioclase feldspar. The amount of both feldspars exceeds the amount of quartz present. Some of the feldspar grains are clean, but most are generally cloudy with sericitic alteration. The quartz grains are always clear and often have corroded boundaries. Patches of carbonate alteration incorporate the matrix material and feldspars, leaving the quartz grains clean. Metavolcanic grains are rounded and generally coarser grained than the quartz or feldspar. Epidote is found both as sand size grains and as matrix material. Muscovite and chlorite occur as detrital flakes lying parallel or subparallel to bedding.



OGS 10 634

Photo 3–Chlorite spotting within finely laminated argillite. Micro aggregates of epidote are related to the chlorite spots, but are not visible in crossed nicols.

WACKE

Massive, unbedded wackes are not common within the Coleman Member. These rocks appear to be genetically similar to the pebbly wackes. They are grey-green, unsorted, and contain angular 1 mm quartz grains typical of the Coleman Member rocks within the map area. A single outcrop of this wacke is seen along Highway 558 at the Firstbrook-Barr township line where it is in fault contact with basal Firstbrook Member argillite.

METAMORPHOSED COLEMAN MEMBER ROCKS

These metasediments are found along the upper contact of the Twin Lake sill; the sill in northeastern Firstbrook Township and the sill around Portage Bay. Effects produced by the metamorphism are chlorite spots and streaks and aggregates of epidote. The metamorphic effects are due entirely to the intrusion of Nipissing Diabase sills and consist of a full spectrum of metamorphic effects ranging from partial melting to slight baking. Partial melting occurs within 0.5 m of the contact: the rock has a "marble cake" (gneissose) texture which, in the vicinity of Portage Bay, has been injected with granophyre. As the distance from the diabase contact increases, the recrystallized, chlorite-spotted sediments retain many of their primary structural and sedimentologi-

cal features. Photo 3 shows microscopic chlorite spotting in an argillite overlying the diabase near Pike Lake.

Firstbrook Member

The Firstbrook Member of the Gowganda Formation, which conformably overlies the Coleman Member, is the most widespread unit in the map area. It is typified by low dips and little topographic relief. The lower part of the Firstbrook Member consists of black to grey, thinly laminated shaley argillite. The middle and most extensive part consists of thickly laminated, red siltstone and brownish red shale with discontinuous beds of silty chloritic material. In the upper part of the section, the siltstone gives way to a fine-grained red wacke that, with increasing stratigraphic height, increases in bed thickness and amount, but still contains wispy red shale beds. The top of the member consists of very thin to thin beds of red wacke with minor discontinuous shale and siltstone.

The basal, black to grey shaley argillite can be traced from the southeastern end of Pike Lake to the western map boundary. The width of areal exposure of this basal part increases to the west, indicating a possible thickening of the succession in that direction. These shaley argillites weather light grey to buff white and range in fresh colour up section from black to grey. They are thinly laminated (Photo 4) with a range in bed thickness from less than 1 mm to 3 mm. Discontinuous pods and lenses of chlorite-rich silty material occur intermixed with the clay beds (Photo 4). The laminae are continuous on an outcrop scale except for an outcrop north of Red Pine Point on the Montreal River where a 2.5 m minimum thickness of black argillite has undergone soft sediment deformation. This convolute horizon is overlain by planar laminae. Pods of carbonate material are interbedded with the fault brecciated and contorted grey argillite laminae seen on outcrops adjacent to Highway 558 at the Barr-Firstbrook township line. At Mattawapika Dam, a curvilinear, polygonal pattern was observed on the top of a bedding surface and may be the planar expression of ball and pillow structures.

Thin section study indicates an increase in silt content in the basal part of the Firstbrook Member from east to west. Samples from south of Pike Lake had approximately 7% subrounded to rounded, very fine sand to fine silt-sized quartz grains in a clay-sized chlorite and sericite matrix. Samples from west of Montreal River had approximately 18% subrounded to subangular very fine silt-sized quartz grains in chlorite and sericite clay. Dark thin laminae beds visible throughout the sequence are composed of chlorite and muscovite flakes and some coarse quartz silt grains. The presence of epidote and carbonaceous material was also revealed from thin section examination as well as minor carbonate alteration along bedding planes.

Gradational with the black to grey argillites are thickly laminated, red, siltstones, shales, and dark green chloritic beds. Characteristic of this middle part of the Firstbrook Member is its red to reddish grey weathered and fresh surfaces. The red colouration is produced by finely disseminated clouds of hematite in the shaley and silty argillite beds.

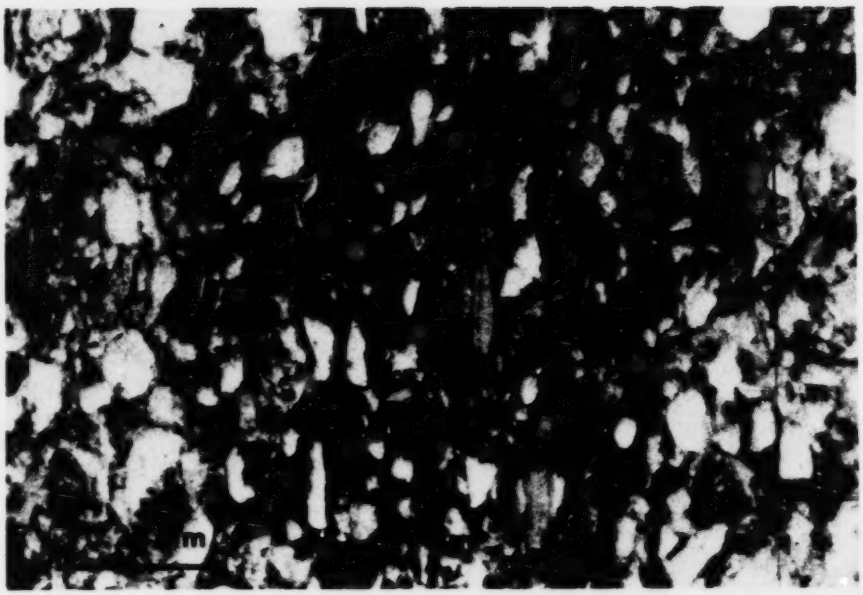
The rocks are distinctly bedded and thicknesses range from thin lami-

OGS 10 635

Photo 4–Basal Firstbrook Member argillite at the Mattawapika Dam showing thin continuous laminae and lensoidal chlorite-rich beds.

nae to thin beds with the average being thick laminae. Siltstone and silty shale with wispy interbeds of well-sorted shale are the most common lithologic types. The frequency of red and grey wacke beds increases toward the top of the member. Sedimentary structures are poorly exposed in outcrop, but ripple marks and crossbeds are common, and sole marks were observed in some disrupted bedrock locations.

Ripple marks, ripple cross laminae, graded beds, and channel marks are visible upon examination of thin sections. The thicker bedding features seen in hand sample usually consist of very thin laminae. All lithologic types are poorly sorted, containing both silt-size particles and clay-size material. In



OGS 10 636

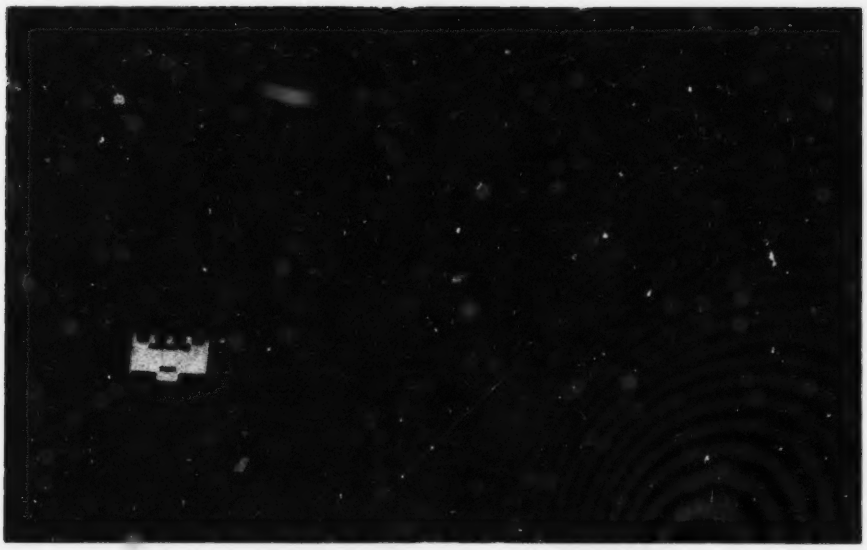
Photo 5–Photomicrograph in plane polarised light of detrital flakes of chlorite in bedded Fristbrook Member wacke.

any particular thin section, the subrounded to subangular quartz particles are approximately the same size. Clay-sized chlorite and sericite are the predominant rock forming material with grains of quartz, epidote, feldspar, muscovite, chlorite, and opaques making up the rest of the silt-size fraction. The amount of feldspar present increases up section. Carbonate alteration is common in both the finer and coarser beds. Photo 5 is a photomicrograph of a wacke from the Firstbrook Member showing elongate flakes of detrital chlorite.

Soft-sediment deformation is not prevalent throughout the whole sequence, but it is conspicuous in the area of large outcrop northeast of Moose Lake. Large Z-shaped drag folds are common, as are disrupted bedding and variable dips. This deformation can be found in outcrops occurring within an arcuate, concave southwest pattern which may indicate an area of instability within the paleobasin.

Sedimentary deformation and brecciation also occurred in the semi-consolidated Firstbrook Member rocks as a result of faulting. A fault can be traced from the Montreal River through the Highway 558 Barr-Firstbrook township line junction and then to the east-northeast by noting deformed sediments. Photo 6 shows convoluted bedding and individual displaced blocks.

The top part of the Firstbrook Member is of variable thickness and varies between 1 m and 8 m. The contact between the Firstbrook Member and Lorrain Formation is shown in Photo 7. The predominant lithologic type is reddish grey to greyish red, very thinly to thinly bedded wackes, with lesser amounts of



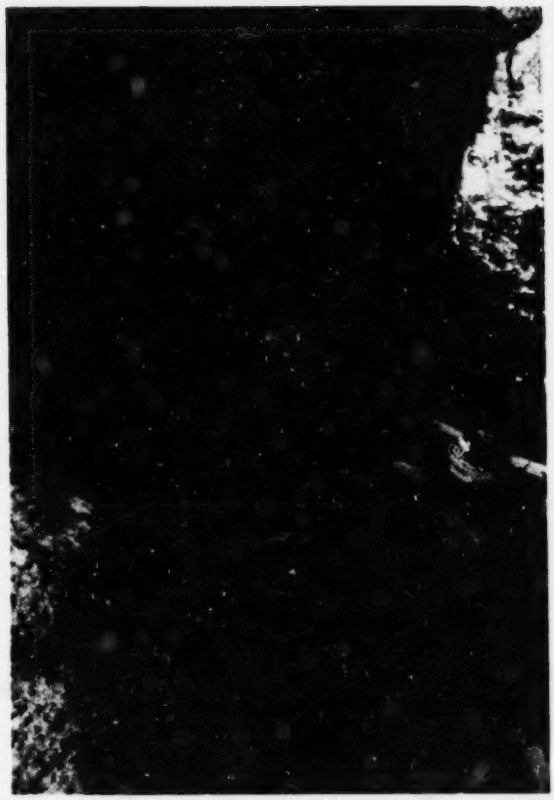
OGS 10 637

Photo 6–Fault-induced deformation in the red silt and shale part of the Firstbrook Member. Photo taken southwest of the Highway 558, Barr-Firstbrook Township line Junction.

thickly laminated red siltstone and brown shale. The wacke beds exhibit ripple marks, graded bedding, crossbedding, load casts, and minor soft sediment deformation. The thickness of beds in the wacke increases as the base of the Lorrain Formation is approached. Around McLennon Lake, the top of the Firstbrook Member has been brecciated and incorporated into the base of the Lorrain Formation. Here, thick arenaceous beds contain broken, tabular argillite clasts ranging in size from less than 1 cm to 50 cm by 4 cm. These pieces may be subparallel to bedding, rotated with respect to bedding, or deformed.

The sandstones are moderately sorted with subrounded, spherical, and tabular fine sand to coarse silt-sized grains. There are both clast-supported and matrix-supported portions within the same thin section. The matrix-rich parts exhibit a faint lamination and the platy, detrital chlorites are parallel to bedding. Quartz grains are the most common clastic fraction with only 1 to 2% subhedral plagioclase grains. The matrix appears to be predominantly sericite. Carbonate alteration occurs in patches within the matrix.

Metamorphosed Firstbrook Member sedimentary rocks are found above and below the Nipissing Diabase sill in northeastern Firstbrook Township and above the sill east of Moose Lake. Except for those rocks immediately adjacent to the diabase, the metasediments retain all their sedimentary features. The effect of the metamorphism has been to slightly recrystallize the sediments and give them a blocky fracture. These metasediments retain their pinkish weathered surface, but the fresh surface is grey. Chlorite spotting occurs immediately next to diabase where bedding had been destroyed. Partial melting and



OGS 10 638

Photo 7–Contact between the upper part of the Firstbrook Member. The base of The Lorrain Formation is the thick massive bed above the hammer handle. Photo taken southwest of Buttons Corners.

intrusion by granophyric dikelets was seen near the natural gas pipeline north of Highway 558.

The recrystallized sediments are fine grained and lack a sericitic matrix, while the clastic grains have common sutured borders. Subhedral chlorite and muscovite are common metamorphic minerals. Andalusite and biotite were observed in one sample.

LORRAIN FORMATION

Lorrain Formation arkose and wacke conformably overlie the Firstbrook Member of the Gowganda Formation. To the west, in the Maple Mountain area, the Lorrain Formation has an average thickness of 1500 m (Card *et al.* 1973). Within the present map area the thickness is much reduced and may be in the

range of 150 m. A wedge of Lorrain Formation between the Latchford Fault and the Nipissing Diabase dike on Kitt Creek is estimated to be about 235 m thick. The diabase lies along a fault which has downfaulted the eastern side by 176 m. The basal member of the Lorrain Formation, as interpreted by Card *et al.* (1973), has been mapped by the author in the present map area as the thin, upper part of the Firstbrook Member. This was done because these rocks form a transition zone, resembling the Firstbrook Member lithologies. The base of the Lorrain Formation is taken to occur with the appearance of thickly bedded, maroon wackes (Photo 7). The contact is generally sharp, but minor interbeds of argillites with the thickly bedded wackes were observed.

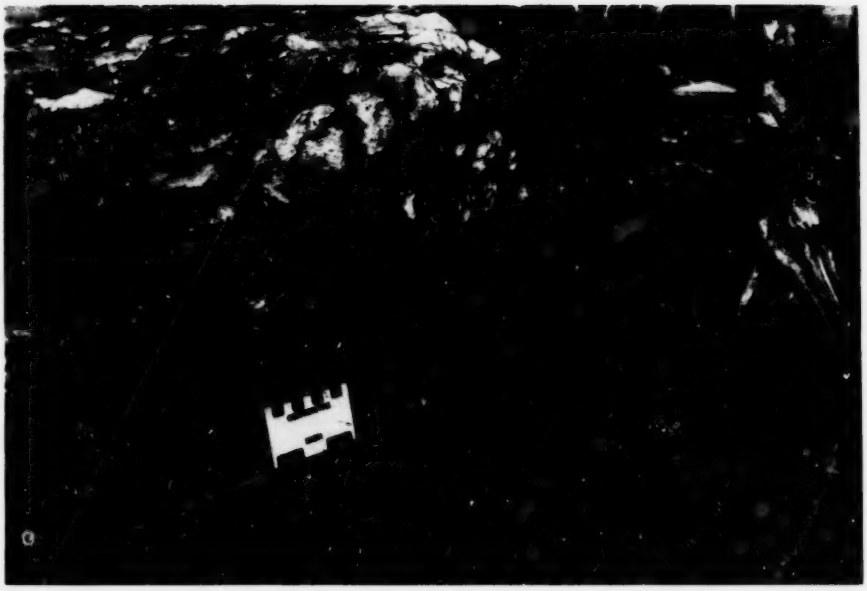
The basal part of the Lorrain Formation in the map area is composed of maroon wackes. These rock types have been reported to occur at the base of the Lorrain Formation in other parts of the Huronian (Wood 1975; Siemiatkowska 1978). These rocks vary from maroon to reddish grey on both the weathered and fresh surfaces. Thickness of beds can be as much as 50 cm; 10 to 30 cm is normal. These beds are commonly thinly laminated, crossbedded, and rippled; load casts (ball and pillow structures) are not uncommon. The maroon wackes grade up into greenish arkoses over a 2 to 3 m distance, and in some localities, there is interbedding of the maroon and green beds.

These wackes consist of poorly sorted, matrix-supported coarse silt- to fine sand-sized, subrounded to subangular grains of quartz and feldspar. The matrix consists of sericite and chlorite, and composes about 50% of the rock. The amount of quartz exceeds the amount of feldspar; the quartz is clear whereas the feldspar is partly sericitized. The red colouration of the rock is due to hematite dust in the clay matrix. Current textures are faintly outlined by light coloured laminations and cross laminations of chlorite and clay minerals.

The generally medium-grained arkoses that overlie the basal maroon wackes are greenish grey on fresh surface and buff coloured on the weathered surface. Bed thicknesses are in the 1 to 3 m range, but many sections with 1 cm to 10 cm and 10 cm to 100 cm thick beds were observed. Ripple marks, cross laminae, soft-sediment deformation, and load casts were seen in the thinner beds. The thicker beds contained some large scale crossbeds as well as some ball and pillow structures (Photo 8). The crossbeds and cross laminae are highlighted by the presence of biotite flakes. Generally the thicker beds are massive and featureless.

The greenish grey arkoses are moderately sorted; the subrounded to subangular clastic fraction ranges in size from fine silt to very coarse sand. The average range in size seems to be coarse silt to medium sand. Clast-supported arkoses are the rule, but in some of the more poorly sorted beds they are matrix-supported. The chlorite and muscovite flakes are subparallel to the bedding (Photo 9). Lower in the section, the quartz grains slightly outnumber the feldspar grains. Between Portage Bay and Kitt Creek, where the Lorrain Formation is thicker, the amounts of feldspar and quartz are approximately equal. Both spheroidal and elongate grains are found. The feldspar grains are partly altered to sericite in most locations. Some thin sections have grains that are completely altered, and grains that are partly altered. Some clear quartz grains and altered feldspar grains are illustrated in Photo 10. Carbonate alteration patches are found within some of the thin sections.

Quartz arenites are not common within the map area. On the southeastern



OGS 10 639

Photo 8–Large scale load clasts in the Lorrain Formation south of McLennon Lake.

corner of Malcolm Lake, an exposure of light grey to orange, fine-grained, brittle quartz arenite underlies the greenish grey arkose.

Metamorphosed Lorrain Formation rocks are found southeast of McLaren Lake. These rocks are grey to green, fine-grained recrystallized rocks with a sugary texture. Bedding features are retained, but the rock has acquired a blocky break. Small chlorite spots were observed on one outcrop. In thin section, it was observed that all grains were recrystallized and that metamorphic chlorite grains were distributed evenly throughout the slide. Poikiloblastic epidote was observed in vuggy parts of the thin section.

Depositional Environments of Huronian Rocks

Many people have studied the Gowganda Formation and it is generally believed to have been deposited in cool climatic conditions (Schenk 1965; Young 1968; Casshyap 1969; Lindsey 1969; and Wood 1973). Schenk (1965) has summarized features that support a glacial origin for the Gowganda Formation. The following account is the author's conclusions on the subject.

Deposition of the Coleman Member rocks was a result of episodic advance and retreat of glacial ice. The thick, massive, pebbly wackes, and the matrix-

OGS 10 640

Photo 9–Lorrain Formation arkose with muscovite grains subparallel to bedding, plane polarised light.

OGS 10 641

Photo 10–Altered feldspar grainsin Lorrεin Formation arkose. Crossed nicols.

supported conglomerates are considered to be tillites and were deposited during the glacial advances. The thick succession of massive and laminated argillites are considered to be distal lacustrine deposits formed in an ice front lake during the retreat of glacial ice. Ice rafting of pebbles and cobbles is indicated by the presence of many "dropstones" in the argillites. The better sorted arkose may be more proximal to the ice front. A fluvial environment, and reworking of till is indicated by arkoses and the lensoid shaped bodies of clast-supported conglomerate.

Rocks of the Firstbrook Member have been mapped in Henwood Township 10 km to the north (Thomson 1966) in Van Nostrand Township (Card *et al.* 1973) to the west and in Bucke Township (Thomson 1956) to the east. The Firstbrook Member rocks were deposited in a series of basins. This series of basins may have been part of one large body of water, with each discrete basin being outlined by submarine arches or ridges. Within the map area, there appears to be 2 basins of deposition separated by the Montreal River. These basins were deep, as is shown by the basal, black to grey, unoxidized argillite. Sediment influx was slow and gentle as indicated by the very thin laminae and the very fine grain sizes. As the climate warmed up, the rate of sedimentation increased into a shallower water environment, as indicated by the increase in the amount of the silt and wacke components and the red hematite dust in the silty and clayey beds. Turbidity currents may have been an active deposition mechanism as is indicated by the presence of sole marks. These turbidite beds are not very thick. Lindsey (1969) postulated the existence of glaciolacustrine turbidites in the Gowganda Formation. The top of the Firstbrook Member appears to be transitional into a fluvial environment with thicker wacke beds and the presence of ripple marks, crossbeds, and graded beds. This fluvial environment continues on into the Lorrain Formation.

Figure 4 is a ternary plot showing the variation in mineralogical composition of the Coleman and Firstbrook Members of the Gowganda Formation and the Lorrain Formation. All the samples plotted have less than 50% quartz which is indicative of immature sediments, possibly with a volcanic provenance. Card *et al.* (1977) have prepared similar ternary plots for the Sudbury-Espanola area showing that the quartz content is higher than this in the Gowganda and Lorrain arkose and wacke, indicating the existence of a granitic source area as opposed to a volcanic source area in the Cobalt region. The range in percentage of the matrix material in the sandstones of both formations is approximately the same in both locations indicating similar degrees of sorting and maturity.

MAFIC INTRUSIVE ROCKS

Nipissing Diabase

The Nipissing Diabase commonly forms sill-like bodies intruding the Early and Middle Precambrian rocks. Dike-like bodies of Nipissing Diabase are found in Kittson Township and joining the Portage Bay sill and the sill east of

Firstbrook Area

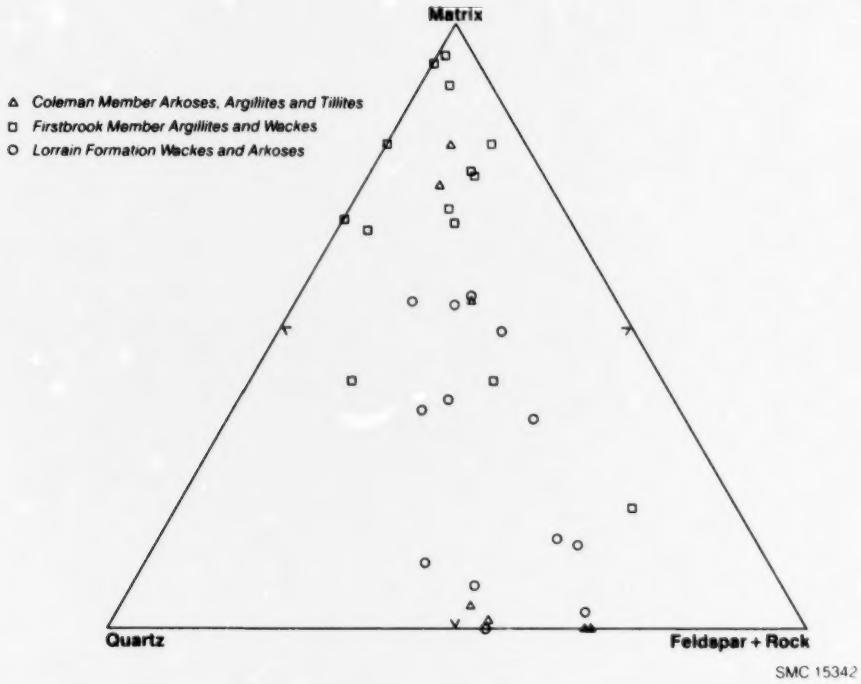


Figure 4–Ternary plot to show the variation in mineralogical composition of the Coleman Member, Firstbrook Member, and Lorrain Formation rocks.

OGS 10 642

Photo 11–Photomicrograph of chilled diabase exhibiting radiating feldspars in a chloritic, seriatic, carbonate, epidote groundmass.

Moose Lake. Hriskevich (1968) noted that the sills in the Cobalt area range in thickness from 100 to 2000 feet. The sills in the map area are thought to be about 300 m thick. These sills can be subdivided into chilled margins, massive quartz diabase, varied textured diabase, granophyric diabase, granophyre, and porphyritic diabase.

The chilled diabase was observed along the upper contact of the Portage Bay sill and along the lower contact of the sill in northeastern Firstbrook Township. The chilled zone ranges from less than 1 m thick to 5 m thick, with the average thickness being about 1 m. The rock is dark green on both weathered and fresh surfaces, aphanitic, and is cut by epidote veinlets. Alteration is extensive and the rock consists of a cryptocrystalline mass of sericite, chlorite, carbonate, and epidote. The few remaining recognizable feldspars form plumose and radial rosette like patterns (Photo 11).

The majority of the Nipissing Diabase sills consist of massive, equigranular, fine- to medium-grained, diabasic to ophitic, diabase to quartz diabase. Large scale columnar joints are seen in cliff faces. The diabase is dark green on the fresh surface and weathers either brown or dark grey. The hypersthene-rich diabase weathers brown. These rocks are commonly non-magnetic to slightly magnetic. In thin section, these rocks are, for the most part, highly altered, with the pyroxenes altered to chlorite and biotite and the plagioclase altered to sericite and epidote. Minor interstitial granophyric intergrowths of quartz and feldspar occur between the altered grains. Magnetite and leucoxene

form small euhedral and boxwork crystals. A partly altered rock contained zoned, slightly saussuritized plagioclase, averaging An_{54} in composition, and zoned pyroxene with minor chlorite alteration. The pyroxenes are pigeonite with minor augite. The wormy intergrowth texture of inverted pigeonite rims the pigeonite crystals, and occasionally incorporates the whole grain. Quartz occurs as granophyric intergrowths and as interstitial crystals. Augite partly altered to uralite and chlorite was found in samples of the diabase just south of George Lake.

Varied textured diabase occurs towards the top of the sill and consists of irregular patches of coarser grained diabase, faint convolute banding, and pegmatitic pods. The varied textured diabase also incorporates the granophyric diabase which also occurs towards the top of the sill. This varied textured diabase type is essentially a potassic-feldspar rich diabase and the potassic feldspar imparts a brownish pink tinge to the weathered surface of the rocks. The quartz content, in the 15 to 20% range, is greater at the top than at lower levels in the sill, and the mafic minerals constitute about 30 to 40% of the diabase. The mafic mineral is subhedral hornblende with some alteration to chlorite.

The granophyre is not extensive and only occurs as small pods and dikelets. Some of the dikelets intrude the partly melted sediments that overlie the diabase. The granophyre is pink on both the fresh and weathered surfaces, fine grained, inequigranular, and has a sucrose texture. It contains both rounded clear quartz grains and granophyric intergrowths of quartz and feldspar, euhedral to anhedral potassic and plagioclase feldspars, chlorite clots and grains, as well as the infrequent grain of epidote. Euhedral magnetite crystals are uncommon.

Porphyritic diabase occurs in the dike that joins the Portage Bay sill from the sill that is east of Moose Lake. The presence of phenocrysts is sporadic. The porphyritic parts consist of irregularly shaped glomerophenocrysts of pink feldspar set in a dark green crystaline matrix.

Four whole rock chemical analyses were done on the Nipissing Diabase. The results are tabulated in Table 3 and are plotted on Figures 2 and 3. Table 4 gives the sample locations within the map area. In order to compare results, 52 analyses for Nipissing Diabase from outside the area were also plotted. For the most part they are high-iron and high-magnesium tholeiitic basalts in composition (Figure 2). The cation plot indicates a tholeiitic differentiation trend. On both figures, the points that plot in a more aluminous or alkalic position are representative of the granophyric parts of the diabase. The high degree of alteration in the rocks seen in the map area suggests that these analyses may not represent primary chemical compositions.

Further reading on the petrology of the Nipissing Diabase sills found between Sault Ste. Marie and Cobalt may be found in works by the following authors: Hriskevich (1968), Jambor (1971), Card and Pattison (1973), and Card *et al.* (1973).

TABLE 3 CHEMICAL ANALYSES OF NIPISSING DIABASE SILLS FOUND WITHIN THE FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS AREA.

Sample Number	79-15 170	79-15 298	79-15 449A	79-15 471
Irvine & Baragar Rock Name	tholeiite diabase	tholeiite diabase	tholeiite diabase	tholeiite diabase
SiO_2	51.70	51.00	51.40	54.10
Al_2O_3	14.90	14.60	15.40	15.10
Fe_2O_3*	11.60	12.00	12.40	13.20
MgO	6.39	6.78	6.50	3.36
CaO	9.37	9.76	8.08	4.23
Na_2O	2.12	0.11	2.66	5.89
K_2O	1.10	0.01	0.53	0.89
TiO_2	0.89	0.87	0.88	1.97
P_2O_5	0.11	0.10	0.11	0.17
MnO	0.17	0.17	0.14	0.22
CO_2+	0.26	1.08	0.58	0.31
S+	0.08	0.09	0.09	0.01
L.O.I.#	2.00	4.90	2.10	1.10
Total	98.69	96.57	98.77	99.45
S.G.	3.01	2.98	2.89	2.90
		CIPW Norms		
AP	0.3	0.2	0.3	0.4
PY	0.2	0.3	0.3	0.0
IL	1.7	1.7	1.7	3.8
OR	6.7	0.1	3.2	5.4
AB	18.4	1.0	23.2	50.8
AN	28.6	41.6	29.4	12.4
MT	3.6	3.6	3.6	5.1
EN	12.1	15.8	14.2	6.7
FS	8.9	11.7	11.4	8.3
Q	4.5	16.7	3.7	0.0
DI	9.1	4.5	5.4	3.2
FO	0.0	0.0	0.0	0.2
FA	0.0	0.0	0.0	0.3
HE	5.9	2.9	3.8	3.4

* Fe_2O_3 as total iron
+ Included in L.O.I.
# Loss on ignition
% Andesitic composition
Chemical Analyses by Geoscience Laboratories, Ontario Geological Survey.

TABLE 4 LOCATION OF SAMPLES TAKEN FOR CHEMICAL ANALYSES, FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS AREA.

Field Number	Township	Latitude	Longitude	Laboratory Number
79-15-070	Firstbrook	47°24′38″	79°49′43″	79-4827
79-15-170	Kittson	47°22′47″	79°53′37″	79-4828
79-15-298	Coleman	47°23′23″	79°50′04″	79-4829
79-15-449A	Firstbrook	47°29′25″	79°46′20″	79-4831
79-15-471	Firstbrook	47°29′00″	79°45′44″	79-4832
79-15-431	Barr	47°25′04″	79°54′31″	79-4830
79-15-475	Firstbrook	47°29′20″	79°45′47″	79-4833

Late Precambrian

MAFIC INTRUSIVE ROCKS

Narrow diabase dikes with a general northwest trend, believed to be correlative with Keweenawan dikes (Thomson 1956), intrude the Middle Precambrian Huronian sedimentary rocks and Nipissing Diabase. Two of these dikes are found in southeastern Barr Township, and a third is located southeast of Mowat Lake. These 3 cannot be traced for any great distance. The longest in the map area is the Sharp Lake dike, found in the northeastern part of the map area, and can be traced for 10 km in a straight line to Sharp Lake in Bucke Township (Thomson 1956).

Except for the dike that crosses the Barr-Firstbrook township line, these dikes are highly altered and filled with quartz and epidote veinlets. The abovementioned dike is totally unaltered and consists of ophitic textured, medium-grained augite, euhedral andesine to labradorite, and euhedral to subhedral magnetite. The other dikes are highly saussuritized and the pyroxenes are altered to chlorite and hornblende. Clean epidote patches are seen superimposed on the altered mass in 1 of the thin sections. These highly altered diabase dikes may be older than Keweenawan in age, but they are younger than the Nipissing Diabase sills they intrude.

The Sharp Lake dike has granophyric parts associated with it and has been highly fractured and filled with quartz and epidote veins. It is difficult to distinguish between the younger dikes and the Nipissing Diabase sills where they are found in intrusive contact. The younger rock has recessive weathering and forms a steep sided linear valley within the diabase sill in northeastern Firstbrook Township.

The results of whole rock analyses of 2 Keweenawan dikes are given in Table 5 and are plotted on Figures 2 and 3. The two dikes analyzed are the east-

TABLE 5 | CHEMICAL ANALYSES OF KEWEENAWAN DIABASE DIKES FOUND WITHIN THE FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIP AREA.

Sample Number	79-15 431	79-15 475
Irvine & Baragar Rock Name	tholeiite diabase	tholeiite diabase
SiO_2	49.10	51.20
Al_2O_3	13.50	15.20
Fe_2O_3*	16.60	12.90
MgO	5.38	4.62
CaO	8.15	7.82
Na_2O	1.73	4.58
K_2O	0.14	0.60
TiO_2	2.00	1.36
P_2O_5	0.25	0.16
MnO	0.20	0.20
CO_2+	0.14	0.21
S+	0.15	0.02
L.O.I. #	3.10	1.40
Total	97.34	98.87
S.G.	3.03	2.95
		CIPW Norms
AP	0.6	0.4
PY	0.4	0.1
IL	4.0	2.6
OR	0.9	3.6
AB	15.3	39.7
AN	29.9	19.6
MT	5.3	4.2
EN	11.9	3.3
FS	13.5	3.5
Q	9.4	0.0
DI	4.4	8.2
FO	0.0	3.3
FA	0.0	3.9
HE	4.4	7.6

Footnotes

* Fe_2O_3 as total iron
+ Included in L.O.I.
# Loss on ignition
Chemical Analyses by Geoscience Laboratory, Ontario Geological Survey

trending dike in Barr Township and the northern part of the Sharp Lake dike. The plotted positions on the cation plot and the Irvine and Baragar (1971) AFM plot, indicate that these diabases are tholeiitic basalts in composition.

Major Aeromagnetic Anomaly

The Geological Survey of Canada aeromagnetic map of this area (Geological Survey of Canada 1965) delineates a large scale, triangular-shaped anomaly that encompasses the area between Red Pine Point on the Montreal River, the southern shore of Pike Lake, and the western shore of Moose Lake. A recently-released gravity map of the area shows no gravity anomaly coincident with this magnetic anomaly (Gupta and Wadge 1980).

The depth to the anomaly as calculated by V.K. Gupta (1979, personal communication, Geophysicist, Ontario Geological Survey, Toronto) is 1392 m. If it can be assumed that this anomaly is an expression of an Early Precambrian basement lithology exposed at the Archean-Proterozoic unconformity, then the depth of the base of the Huronian succession in this position is 1392 m. If the anomaly is due to a magnetite-rich, mafic Nipissing-type intrusion, then the depth to basement cannot be interpreted. The Nipissing Diabase sills exposed within the map area are generally magnetite poor, so if this is a Nipissing-type intrusion, it must be a magnetite rich differentiate.

Cenozoic

QUATERNARY

Pleistocene and Recent

A variety of Pleistocene and Recent deposits cover 70 to 80% of the map area. Pleistocene glaciation was from the north-northeast as indicated by striations and gouging on bedrock outcrops. Glacial fluting is seen in the ground moraine deposits in south-central Firstbrook Township.

The most extensive of the Pleistocene deposits is the thin cover of sandy ground moraine east, and hummocky moraine west of the Montreal River. A linear belt of sand and gravel deposits that stretch from Bartle and Spring Lakes to Loon Lake was deposited by glaciofluvial processes as an ice contact delta. Around George Lake, the ice contact delta grades into a sandy outwash fan. To the east of this ice contact delta and outwash material, is a sand and clay glaciolacustrine plain. The western boundary of this glaciolacustrine plain is a steep-sided hill composed of well-sorted, water-washed boulders (Photo 12), found west and south of Spring Lake, west of Moose Lake, and northeast of Reid Lake. The farms in Firstbrook Township are underlain by this material. The farmland in the northeastern corner of the map area is underlain by glaciola-

OGS 10 643

Photo 12–The steepsided, waterwashed boulder hillside is the eastern boundary of the glaciofluvial material. Photo taken south-southwest of Spring Lake.

custrine clayey silt of the Little Clay Belt. For a more detailed explanation of the Quaternary deposits and their engineering features *see* Roed (1979).

Recent organic deposits, composed of peat, are widespread, but do not occur in large bodies. Most are located along seepage paths or poorly developed streams. Many more occur in small local depressions.

STRUCTURAL GEOLOGY

The Cobalt Embayment, once considered to be undeformed, is currently known to have been affected by Proterozoic orogenic events and these slightly deformed rocks are considered to be external parts of the Penokean Fold Belt

(Card *et al.* 1972). For the most part, the rocks within the map area can be considered to be undeformed, except for those adjacent to faults.

The Huronian sedimentary rocks within the map area are gently dipping to flat lying. The region to the east of the Montreal River is basin shaped, and the strikes and dips, except for local irregularities, reflect this feature. The strikes and dips of the rocks to the west of the Montreal River are more irregular, but the sequence becomes younger to the south. The irregularities in the strikes and dips, except around some faults, are thought to reflect the underlying Archean topography.

Folds

Evidence for large scale folds, similar to those found to the west by Card *et al.* (1973) was not found within the current map area. Supratenuous folds are thought to account for the variation in strikes and dips seen in the sediments.

Small scale tectonic folding of Firstbrook Member sediments was observed at 2 localities, 1 in, and the other out of the map area. A small monocline was noted just southwest of the northwest-trending Keweenawan dike in Barr Township. This is a small scale local fold with a north-facing limb and an axial plane that plunges 5 degrees in a 120 degree azimuthal direction. An open gentle syncline was observed in rocks north of the map area in Hudson Township.

Slump folds due to large scale soft-sediment deformation were observed in the Firstbrook Member sediments near Highway 558 northeast of Moose Lake in Bucke Township. The curved nature of the outcrop pattern suggests that this area was the edge of the paleobasin of deposition for the Firstbrook Member sediments, and tectonic activity may have caused slumping into the basin itself.

Faults

The most prominent structural feature in the map area is the Latchford Fault which trends northwest, parallel to the Montreal River. The Cross Lake Fault, a major fault, crosses the northeastern corner of the map area. It dips 65° to the northeast and is an important feature of the Lake Timiskaming Rift Valley as proposed by Lovell and Caine (1970). These authors proposed a 500-foot dip slip displacement for the valley (northeastern) side of the Cross Lake Fault and a 100-foot down fault to the northeast on the Latchford Fault. These 2 faults are the youngest structural features in the map area.

Aside from those associated with the Lake Timiskaming Rift Valley, faults and lineaments within the map area trend northwesterly or northeasterly. East of the Latchford Fault, the predominent trend is northeasterly, and 5 faults have been recognized. West of the Latchford Fault, 2 faults have been noted, both with northeasterly trends as opposed to the lineaments which trend northwesterly.

Three curvilinear faults occur in the central part of the map area. Of these

faults, the 2 longest can be traced from the Montreal River to a point southeast of Pike Lake, just east of Pike Creek. The outcrops close to this fault exhibit soft-sediment deformation, brecciation, and steeper dips. The change in stratigraphy across the faults suggests that these 2 faults bound a wedge or horst of rock that has had stratigraphy downfaulted on both sides, and the amount of displacement on the faults decreases towards the Montreal River. A similar shaped fault just north of Malcolm Lake has been downfaulted to the northeast. Thus, there is a shallow graben between the fault near Malcolm Lake and the one immediately to the northwest. The change in stratigraphic position across these faults is not great; the total change may not be greater than 20 to 30 m. Two minor northerly trending faults are present west of and south of Moose Lake. The fault west of Moose Lake does not affect stratigraphy, but the fault south of Moose Lake displaces the diabase dike slightly.

There are 2 faults west of the Montreal River. A curvilinear fault passes through the Cobalt-Kittson Mine on Kitt Creek, down-faulting the eastern side 580 feet (Assessment Files Research Office, Ontario Geological Survey, Toronto). This fault fractured the diabase and sediments, and permitted the passage of fluids that gave rise to quartz veins. A hitherto unknown thrust fault was discovered south of McLennon Lake. The thrusting direction was towards the southeast where it thrusts the Lorrain Formation and the upper part of the Firstbrook Member over the Lorrain Formation. Sheets of quartz, 12 to 40 cm thick, occur within the fault plane.

Numerous northerly, northeasterly, and northwesterly trending vertical shears are found in outcrops throughout the area. These brecciated shears vary in thickness from 1 to 10 cm, and cannot be traced beyond the outcrops in which they have been recognized by the field party.

ECONOMIC GEOLOGY

Silver was discovered in 1903 at Cobalt, 5 km east of the eastern map boundary. By 1906, prospecting activities fanned outward from the Cobalt area and many undocumented pits and trenches resulted from this activity. The original discovery of the Dotsee Mine (the property of Agnico-Eagle Mines Limited) (1) in Bucke Township was in 1906 (Thomson 1964). In 1907, a 150-foot deep shaft was sunk in Bucke Township on the Sharp Lake Diabase dike at the McKinnon Mine (8) (Thomson 1964). The Canadian Prospect Property (Cobalt-Kittson Mine) (2) in Kittson Township is believed to have been discovered in 1910 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Recent exploration within the map area has been, for the most part, oriented towards the discovery of silver-cobalt mineralization, and, as such, has been concentrated on the following targets:

1. the lower contact of the Nipissing Diabase sill and dike in northern Coleman and southern Firstbrook Townships
2. the Nipissing Diabase east of Moose Lake and north of Highway 558 in the northeastern corner of the map area
3. the Keweenawan, Sharp Lake Diabase Dike and surrounding sediments

Exploration in the map area has been sporadic since 1948. Agnico-Eagle Mines Limited, who currently own the Dotsee Mine in Bucke Township, have done diamond drilling in order to check the extent of mineralization. In 1966, a 2184-foot deep diamond-drill hole was sunk and in the fall of 1979, eight short holes were diamond drilled to check the mineralization in the vein system within the mine. Figure 4 is a planar and sectional view of the mine showing the location of the diamond-drill holes.

The recent discovery in south-central Firstbrook Township of a 0.5 km^2 Archean felsic metavolcanic inlier south of Maggie Lake prompted Copperfields Mining Corporation and Pickle Crow Exploration Limited to check for base metals by having geological, magnetometer, electromagnetic, and self-potential surveys carried out in 1972 (Assessment Files Research Office, Ontario Geological Survey, Toronto).

As of December 31, 1979, unpatented claims in the map area were to be held by James Armstrong, Herbert Johnson, and St. Joseph Explorations Limited. Table 6 is a list of the patented claims within the map area and the person/persons paying the taxes.

During the field season, samples were collected by field party personnel for assay and spectrographic analysis. All quartz veins sampled were assayed for either gold and/or silver. Some samples were also assayed for copper and cobalt. Table 7 gives the location and results for these assays. Thirty element spectrographic analyses have been carried out on selected samples from the lower part of the Firstbrook Member of the Gowganda Formation.

Gold

Since the Cobalt area has been known as a silver area, gold has not previously been of interest within the map area. The only mention of gold is in files on the Cobalt-Kittson Mine (Canadian Prospect Property) in Kittson Township. Gold was reported from the 450-foot and 598-foot levels and assayed at 0.08 and 0.20 ounce of gold per ton respectively (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Twelve samples of quartz veins and sediments were submitted to the Geoscience Laboratories, Ontario Geological Survey, Toronto for gold assays. The samples, as shown in Table 7, had values in the range of less than 2 ppb to 12 ppb gold.

Silver and Cobalt

The map area, due to its close proximity to the Cobalt Mining Camp, has been examined for its silver and cobalt potential (*see* data in the Assessment Files Research Office, Ontario Geological Survey, Toronto). In spite of intensive prospecting, no valuable deposits have been discovered. Three old mines are present within the map area.

The Cobalt-Kittson Mine (Canadian Prospect Property) (2) on Kitt Creek in Kittson Township was developed on quartz veins in a narrow diabase dike

TABLE 6 TABLE SHOWING PATENTED MINERAL RIGHTS CLAIMS IN COLEMAN TOWNSHIP AND THE TAXPAYER FOR THOSE CLAIMS

Claim Number	Lot	Concession	Taxpayer
1941	20	6	Janette Handy Humboldt T.125
1874	18	5	Albert, Carl & Elio Chitaroni T.545
1707	18	5	" " " " "
1959	18	5	" " " " "
1810	18	5	" " " " "
89	18	5	" " " " "
233	18	4	" " " " "
1436	16	6	Estate of James H. Shepherd T. 1068
1437	16	6	" " "
371	15	6	J.E. Armstrong T. 372
2000	15	5	Tormont Mines Limited T.716
1659	15	5	" " " "
1169	15	5	" " " "
1150	15	5	" " " "
1136	15	5	" " " "
RW 211	14	6	Corporation of Township of Coleman
144	13	6	Gerald & Noreen Price T. 1034
208	12	5	Joseph Jacksic T. 1045
183	12	5	" " "
BUCKE TOWNSHIP			
T 23473	SE½ N½ 1	2	William E. Seed T.568
2033	SW½ N½ 1	2	Barbara Cummings
1199	NW½ S½ 1	2	Agnico-Eagle Mines Limited
1331	NE½ S½ 1	2	" " " "
FIRSTBROOK TOWNSHIP			
T 31745-31749	S½ 4	1	Cabol Enterprises Limited L-T 184
T 31752	SE½ NE½ S½ 5	1	

(*see* section on "Property Descriptions" for further details). No silver was reported from this mine, but 272 kg of cobaltite were removed (Resident Geologist's Files, Ontario Geological Survey, Kirkland Lake).

The Dotsee Mine (1) in Bucke Township is a cobalt prospect with minor amounts of associated silver. Thomson (1964) quoted assays of 2.19 and 2.70 percent cobalt with associated silver grading 1.18 and 0.96 ounces of silver per ton. The cobalt occurs in the diabase as finely disseminated cobaltite in widths varying from 24 inches to 60 inches, *see* 'Property Descriptions' for more details. In 1930, 3.16 tons of ore were processed; in 1938, 1000 to 2000 tons were milled, and in 1939, 2000 tons were milled (Thomson 1964).

TABLE 7 | ASSAY RESULTS OF VEIN MATERIAL, IN FIRSTBROOK AND SURROUNDING TOWNSHIPS AREA. ASSAYS BY GEOSCIENCE LABORATORY, ONTARIO GEOLOGICAL SURVEY, TORONTO.

Sample Number	Material	Location and Geology	Gold oz/ton	Gold (ppb)	Silver oz/ton	Copper ppm	Cobalt ppm
79-15-32	Quartz	narrow bull quartz veins in Firstbrook sediments south end of McLennon Lake	tr.	12	tr	NA*	NA
79-15-64A	fine grained feldspathic arenite	very rusty zone of waste rock from the Cobalt-Kittson Mine dump	NA	04	tr	680	NA
79-15-161	Quartz	vein from Lorrain Formation just above contact west of Kitt Creek	tr	03	NA	NA	NA
79-15-309	Quartz	veins in Lorrain Formation outside map area WNW of McLennon Lake	tr	02	NA	NA	NA
79-15-344	Quartz	veins in thin Keweenawan diabase in Coleman sediments SE of Mowat Lake	tr	nil	tr	NA	NA
79-15-432A	Quartz	veins in Keweenawan diabase in Firstbrook sediments SE Barr Tp.	tr	nil	tr	NA	30
79-15-456A	quartz and epidote	veins in Keweenawan diabase in Firstbrook sediments, contains cp and bornite	tr	06	tr	4260	40
79-15-473A	quartz with cobalt bloom	from pit in Sharp Lake Diabase in NE Firstbrook Township	NA	05	tr	NA	2500
79-15479A	quartz and diabase	McKinnon Mine Dump on the Sharp Lake Diabase	tr	02	tr	96	NA
79-15-583	calcite and diabase	Dotsee Mine dump Bucke Township	tr	nil	tr	NA	54
79-15-287	quartz in pebbly wackes	narrow veinlets west side of LeMoyne Lake	tr	06	tr		
79-15-41	quartz and chlorite	thick sheets of quartz in thrust fault south of McLennon Lake	tr	nil			

The McKinnon Mine (8) consists of a 150-foot deep shaft on the Sharp Lake Diabase dike just north of Highway 558 in Bucke Township. Small quantities of cobalt were reported (Thomson 1964).

All of the quartz veins sampled by field party personnel and assayed for silver showed a trace of the metal (*see* Table 7). Norite Mines Limited carried out an exploration programme along the Sharp Lake dike north of Highway 558 in Firstbrook Township. Diamond drilling was carried out and interesting carbonate veins that were intersected were assayed for silver, but the results were not significant (Assessment Files Research Office, Ontario Geological Survey, Toronto). A few of these veins also contained sparce, but visible cobaltite.

Cobalt showings are more common within the area. Old pits and shafts in the Nipissing Diabase sill around Portage Bay are reported to have contained cobalt bloom (Albert Chitaroni, Portage Bay Lodge, personal communication, 1979). Robert Thomson (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) reported the presence of quartz-carbonate veins along the vertical contact between the Nipissing Diabase dike and Lorrain Formation arkoses south of Maggie and Charlotte Lakes. Trenches and shallow pits on these veins revealed veins up to 2 cm wide containing small amounts of disseminated smaltite, bismuth, chalcopyrite, and cobalt bloom.

A deep pit was found in the Sharp Lake dike along its contact with the Nipissing Diabase sill in northeastern Firstbrook Township. A sample of quartz taken by field party personnel from the dump of this pit contained cobalt bloom. This sample, number 79-15-473A, was analyzed and contained a trace of silver and 0.25 percent cobalt (*see* Table 7). Three other samples of quartz veins were submitted for analyses and contained between 30 and 54 ppm cobalt.

Base Metals

Base-metal mineralization is found as disseminated pyrite and chalcopyrite around the Nipissing Diabase sills and dikes, as detrital grains in the Lorrain and Gowganda Formation sediments, as disseminations in fractures in the Sharp Lake dike, and as local concentrations in the felsic metavolcanic inlier.

Disseminated and blebby base-metal mineralization is found associated with both the Nipissing Diabase sills and dikes and in the surrounding sediments. Finely disseminated pyrite crystals have been noted in the diabase up to 3 m from the diabase contact, and local blebs of chalcopyrite occur near the contact (Assessment Files Research Office, Ontario Geological Survey, Toronto). Quartz-carbonate veins associated with the diabase also contain finely disseminated pyrite and chalcopyrite. The Lorrain Formation arkoses in contact with the Nipissing Diabase dike in the Cobalt Kittson Mine (Canadian Prospect Property) contain approximately 1 percent disseminated chalcopyrite and 4 to 5 percent disseminated pyrite by visual estimation. An assay of this material, sample number 79-15-64A (*see* Table 7), contained 0.068 percent copper.

Detrital grains of pyrite were observed in Lorrain Formation arkose, but they are not common. Pebbly wacke of the Coleman Member of the Gowganda Formation contains the occasional flake of chalcopyrite.

Chalcopyrite and bornite were identified in a sample of quartz vein mate-

rial taken from a Keweenawan Diabase dike just north of Highway 558 in Bucke Township. This sample, sample number 79-15-456A (*see* Table 7), contains 0.4 percent copper. Traces of disseminated chalcopyrite, pyrite, and chalcocite have been reported to occur in the diabase in fractures parallel to the contact.

Within the Archean felsic metavolcanic inlier, chalcopyrite occurs as fine disseminations around the periphery of the inlier, minor blebs within quartz stringers within the rhyolite, and disseminations near the lamprophyre dikes cutting the rhyolite. The chalcopyrite around the periphery of the inlier is at the interface of the argillite of the Firstbrook Member of the Gowganda Formation and the metavolcanics. The lamprophyre dikes cutting the metavolcanics are believed to have remobilized the chalcopyrite into local concentrations (Assessment Files Research Office, Ontario Geological Survey, Toronto). The above observations are from the assessment files; and the author did not observe any mineralization within the metavolcanics.

In order to test for the possibility of stratabound base-metal deposits occurring in the fine-grained, thinly laminated, black to grey Firstbrook and Coleman Member argillites, 45 samples were submitted for a qualitative 30 element spectrographic analysis. Elements of interest were copper, lead, nickel, and zinc. None of these metallic elements were found in amounts exceeding the 0.01 to 0.1 percent range (classified as a trace amount). Thirty-eight percent of the samples contained three of the above elements, 27 percent contained two, 20 percent contained four, 9 percent contained one, and 6 percent contained none of these elements. A total of 94 percent of the samples analyzed contained at least one of these base-metal elements.

These results indicate that sedimentary processes deposited base metals in the Huronian sediments in the map area. At the Silverfield Mine in Cobalt, an argillite unit contains thin layers, rich in very finely disseminated chalcopyrite, galena, or sphalerite. The individual layers commonly contain sphalerite, galena, or chalcopyrite in distinct laminae (Patterson 1979).

Description of Properties

The description of a property in good standing on December 31, 1979, is listed by the full name of the company or person who held the property. Descriptions of explored ground containing a mineral deposit on which there are no claims in good standing, are listed by a name derived from the company or party who carried out the exploration work. An unclaimed parcel of explored land in which no mineral showings were located is listed by the full name of the company or person who held the land and by the date in brackets of the last major work.

Table 8 is a listing of the exploration information available on the map area.

The information is based on data in: the Assessment Files Research Office, Ontario Geological Survey, in Toronto; Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake; company information supplied by the Agnico-Eagle Mines Limited in Cobalt, Ontario, and data in the work of Thomson (1964).

TABLE 8 | INFORMATION ON PROPERTIES IN THE FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS AREA ON FILE IN THE ASSESSMENT FILES RESEARCH OFFICE, ONTARIO GEOLOGICAL SURVEY, TORONTO AS OF DECEMBER 31, 1979.

PROPERTY NAME	TOWNSHIP	NUMBER	TYPE OF WORK
1. Agnico-Eagle Mines Limited (Dotsee Mine)	Bucke	1	MD,A,DDH
2. Canadian Prospect	Kittson	2	MD,A,DDH
3. Colebucke Mines Ltd. [1948]	Bucke	3	G,GR,M
4. Colebucke Mines Ltd. [1948]	Bucke	4	G,GR,M
5. Colebucke Mines Ltd. [1949]	Firstbrook	5	M
6. Harmon Occurrence	Firstbrook	6	DDH,A
7. La Pierre Occurrence	Firstbrook	7	G,M,EM,SP,DDH
8. McKinnon Mine	Bucke	8	G,GR,M,DDH,A,MD
9. Old Colony Securities Limited [1960]	Bucke	9	GR
10. Sapphire Petroleums Limited	Firstbrook	10	G,GR
11. Seed Occurrence	Bucke	11	T
12. Silverbucke Mines Ltd. [1949]	Firstbrook	12	M
13. E. Walters [1948]	Firstbrook	13	G,GR

Abbreviations

A . . . . . .Assay
DDH. . . .Diamond Drill Holes
EM . . . . .Electromagnetic Survey
G . . . . . .Geology map
GR . . . . .Geology report
M . . . . . .Magnetic survey
MD. . . . .Mine development
SP . . . . .Self potential survey
T . . . . . .Trenching

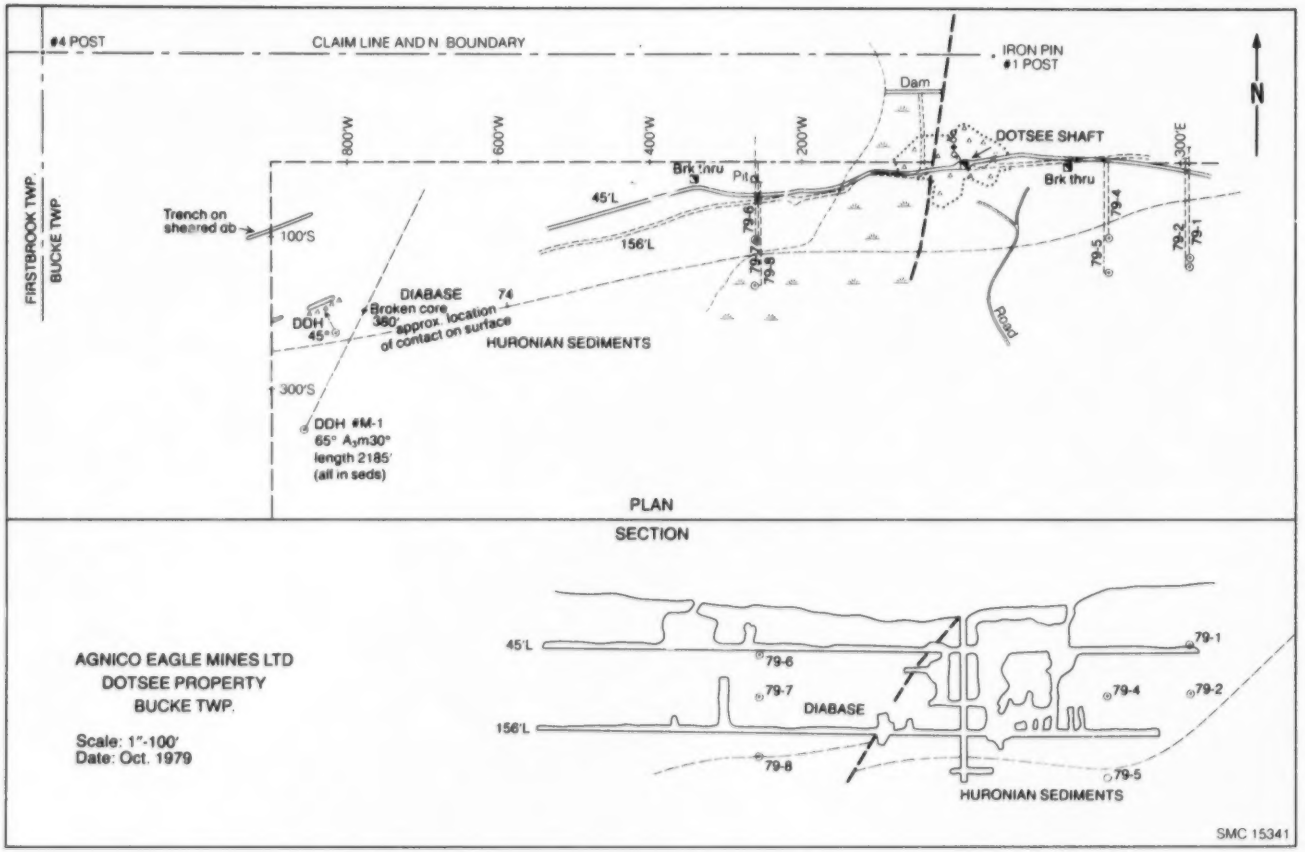


Figure 5–Plan and cross section through the Dotsee Mine in Bucke Township (from Resident Geologist's Files, Ontario Ministry of Natural Resources, Cobalt).

AGNICO-EAGLE MINES LIMITED (DOTSEE MINE) (1)

The Dotsee Mine is located on the northwestern quarter, southern half of lot 1, concession II, Bucke Township. The mine was acquired by Agnico Eagle Mines Limited in 1957[1]. In 1966, Agnico Eagle Mines Limited drilled a 2184-foot long diamond-drill hole through the Lorrain Formation, Firstbrook Member, and into the Coleman Member of the Gowganda Formation. In the fall of 1979, the company drilled 8 short diamond-drill holes for a total length of 1624 feet through the mineralized part of the old mine. The mineralized parts were assayed for cobalt and the results were disappointing. Figure 5 shows the location of these diamond-drill holes in plan and sectional view.

The geological setting and history of ownership of the Dotsee Mine is described by Thomson (1964, p.23-26) as follows:

DOTSEE MINE

The shaft and most of the workings of what is commonly referred to as the Dotsee Mine are situated on the NW.1/4, S.1/2, lot 1, concession II.

The original discovery appears to have been made about 1906 and the Floyd Silver Mines was incorporated in that year to exploit it.

By 1909 a shaft had been put down 115 feet and 60 feet of lateral work done on the 46-foot level. The shaft appears to have been put down to its present depth (some 210 feet) by the company.

The property came into the possession of W.E. Seed (it is sometimes referred to as the Seed Mine) and about 1930 the Yorkshire Cobalt Mining Co. took it over. Surface and underground operations in general on a small scale were carried on intermittently until about 1938. A small and simple concentrating plant was erected but was destroyed by fire before any noteworthy tonnage had been treated.

In 1938 Dotsee Cobalt Mines operated the property under lease sending the ore to the mill of Cobalt Products Limited for treatment. A substantial amount of underground work was done.

In 1939 Wm. Seed and E.H. Todd operated the property, mining and shipping mill ore to the Cobalt Products mill. This appears to have been the last underground work done. Since then the property came into the possession of Silanco Mining and Refining Co. Ltd., and its successor company Cobalt Consolidated Mining Corporation Ltd. Diamond-drilling was done from surface. At present no work is being done.

The writer is indebted to Wm. E. McCready, at one time manager of the Yorkshire Cobalt Mining Co., for plans and information and to Murray Watts, consultant in 1937, for a longitudinal stope section of the workings. Examination by the writer of the surface and dumps yielded little significant information and the workings were not accessible; logs of the drilling were not available.

The shaft collar is in Nipissing diabase, whose contact against Cobalt Series sediments at bed rock surface is reported to be some 50 feet to the south. Watts reported that the contact dipped about 70 + N. and that it was exposed in the shaft at a depth of 180 feet. There is no direct evidence of the thickness of Cobalt Series sediments in the vicinity; in the writer's opinion it may be assumed to be greater than 1,000 feet.

Cobalt was the only metal of economic interest. Silver was present in such small amount that in general assays were not made for it. Nickel appears to have been present in small amount both totally and relatively to the cobalt.

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[1] Geoscience Data Centre, Ontario Geological Survey, Toronto, File Dotsee (Seed) Mine, District of Timiskaming, Bucke Township.

Firstbrook Area

Godard[1] gives the following analysis of two lots (aggregating 250 pounds) used in milling tests.

	Co percent	Ni percent	As percent	Ag oz/ton
1	2.19	0.04	2.84	1.18
2	2.70	0.03	3.55	0.46

McCready stated that most of the ore was fine disseminations of cobaltite through diabase over widths commonly from 2 to 5 feet and that the amount of massive ore present in such form as to be amenable to cobbing was very small. He reported that 6,316 lbs. of ore shipped to Deloro in 1930 yielded 479 pounds of cobalt, that is, it contained about 7.6 percent. Some at least of the concentrates from milling were reported by McCready to be high grade, containing about 20 percent cobalt. From this it seems clear that the cobaltite and/or other cobalt mineral was of excellent tenor but that the amount of cobalt-bearing mineral present was in such small amount as to preclude profitable production by any of the owners of this property. Records of production from the property are not available to the writer. In 1930 a shipment containing 479 pounds of cobalt is reported (Ont. Dept. Mines, Vol.XL 1931, pt.1, p.124); in 1931 cobalt valued at $110.39 was shipped (Ont. Dept. Mines, Vol. XLI 1932, p.112). In 1938 milling cobalt ore to the extent of possibly 1,000-2,000 tons was mined. In 1939 it is reported that 2,000 tons of milling ore was mined (Ont. Dept. Mines, Vol. XLIX 1940, pt.1, p.239).

The vein structure in the underground workings is reported by McCready to be a fault with slickensided cobalt ore of rather common occurrence; pre- and also post-mineralization movements along the fault are thus indicated.

The strike is generally east but variations in this are said to occur locally. As shown by the relative positions of the 45 and 156 levels the dip at the shaft is vertical; west of the shaft it is steeply to the south and east of the shaft steeply to the north. At about 400 feet west of the shaft a pit, possibly 30 feet deep, has been put down on a structural breakage with veinlets containing cobalt mineralization over a width of 5 feet. The vein at the pit strikes N.85°E. and dips 75°S., the writer assumes it is the same vein as that in the underground workings. It appears that the vein structure has been traced over a considerable distance. At about 1,000 feet west of the shaft is an open cut showing quartz carbonate veinlets; presumably this represents the Dotsee vein. Down dip (below 180 feet in the shaft) the vein entered Cobalt Series sediments; it appears that cobalt mineralization persisted in these sediments but was of such a nature as to offer little encouragement for deeper work. Watts shows on a longitudinal section made available to the writer a fault with north strike and dip 50°W. passing through the vein. The fault line appears to lie within 50 feet west from the shaft and to be indicated by a swampy depression trending N.10°E.

Underground work as shown by plans and profiles, thought by the writer to include the last done, includes a shaft some 210 feet deep with levels at 45, 125, 156 and 207 feet. On the 45-foot level drifts were carried 335 east and 550 west of the shaft; on the 125-foot level 40 feet east and west; on the 156-foot level 260 east and 570 feet west; on the 207-foot level 33 feet east and 12 west. Most of the stoping was done near the shaft.

It would seem that the extensive work done to date along this vein structure has yielded little or no information in regard to significant features positioning ore shoots either laterally or at depth.

The rare mineral emplectite (formula $CuBiS_2$) has been reported from this mine by Miller (Ont. Bur. Mines, Vol.xIX 1910, pt.2, p.28) and the present writer gathered from conversation with miners who had worked at the property that in some places at least large specimens of native bismuth had been found.

[1]J.S. Godard, "Experimental flotation tests on cobalt ore from Yorkshire Cobalt Mines, Limited, Cobalt, Ontario", Investigations in Ore Dressing and Metallurgy, Can. Dept. Mines, Mines Branch, Public No. 724, Report No. 375 1930 (1932), p.160.)

CANADIAN PROSPECT (COBALT-KITTSON MINE) (2)[1]

The Canadian Cobalt and Metals Company Limited formerly held 5 claims along Kitt Creek in northeastern Kittson Township. This property may be reached by boat from Latchford up the Bay Lake part of the Montreal River to Kitt Creek.

According to Thomson (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) the first work on the property was probably done in about 1910; before 1927 the shaft was down 55 feet. In 1927, Cobalt Kittson Mines Limited erected a camp and mine buildings, and deepened the shaft to 250 feet (Sutherland *et al.* 1929, p.168). In 1928, the depth of the shaft was increased to 450 feet with 450 feet of drifting on that level and 275 feet of drifting on the 250-foot level (Sinclair, Cleland, Keeley, Jarrett, and Webster 1930, p.170). In 1929, continuous work was carried out. The shaft was deepened by 178 feet to 628 feet with 60 feet of drifting on the 598-foot level. The 450-foot level had an additional 371 feet of drifting carried out on it with 326 feet of cross-cutting (Sinclair, Cleland, Keeley, Cooper, and Webster 1930, p.152). Operations ceased in 1930. Thomson (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) indicated that a reported merger of the Cobalt-Kittson Mines Limited with the Hazleton-Porcupine Gold Mines Limited formed the Kittson-Hazleton Gold Mines Limited in 1934. In 1947, the Canadian Cobalt and Metals Company Limited was incorporated and took over the Cobalt-Kittson Mine. In 1949 the mine was dewatered and a small amount of diamond drilling was done (Williams 1951, p.92).

The mine is situated along the eastern margin of a 76 m wide Nipissing Diabase dike and Lorrain Formation arkose. On the western side of the dike south of Kitt Creek, arkose of the Lorrain Formation outcrops, and north of the creek are exposed siltstone and argillite of the Firstbrook Member of the Gowganda Formation. The base of the Lorrain Formation on the eastern side of the fault was found at a depth of 580 feet indicating that the rocks on the eastern side of the fault has been downfaulted that distance.

The main vein on the property is a fractured and faulted zone striking somewhat irregularly, but generally in a northerly direction. The vein is located on the eastern side of the diabase to a depth of 580 feet, and below that it lies between the diabase and the sediments to the east (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The total production of the mine was 600 pounds of smaltite from the 598-foot level. Robert Thomson (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) indicates that gold was reported in the 450-foot and 598-foot levels. The assays are 0.08 and 0.20 ounce of gold per ton respectively. The amount of silver in the mine was negligible.

[1]Can also be called The Canadian Cobalt and Metals Company Limited (Cobalt-Kittson Mine).

COLEBUCKE MINES LIMITED [1949] (3)

Colebucke Mines Limited formerly held ground in western Bucke Township which included 8 claims in lot 1, concession V. The area is underlain by rocks of the Firstbrook Member of the Gowganda Formation. These rocks consist of thickly laminated red siltstone, and shale with minor lithic arenites which grade up into red thin bedded arenites, subarenites, and siltstones. The sediments were intruded by a gently south dipping Nipissing Diabase sill and are contact metamorphosed along the top of the sill. Both the sediments and the diabase sill have been intruded by 2 northwesterly trending Keweenawan epidotized diabase dikes.

In 1948, a reconnaissance geological survey was carried out over an area which included lot 1, concession V, Bucke Township. As a result of this survey, the company decided to do a detailed geological and magnetic survey in 1949 over the same ground (Assessment Files Research Office, Ontario Geological Survey, Toronto). The ground was subsequently allowed to revert to the Crown.

COLEBUCKE MINES LIMITED [1949] (4)

Colebucke Mines Limited formerly held ground in western Bucke Township which included 8 claims in lot 1, concession IV. The ground is underlain by red siltstones, shales, and lithic arenites of the Firstbrook Member of the Gowganda Formation. These sediments have been subjected to slumping with soft-sediment deformation, and intrusion by narrow diabase dikes of Keweenawan age. Chalcopyrite, pyrite, and chalcocite, are reported in a number of old pits along the Sharp Lake dike, and cobalt bloom has been reported near the intersection of the 2 dikes (Assessment Files Research Office, Ontario Geological Survey, Toronto).

In 1948, a reconnaissance geological survey was carried out, and as a result of this survey, the company decided to carry out a detailed geological and magnetometer survey in 1949 (Assessment Files Research Office, Ontario Geological Survey, Toronto). No further work has been reported on this property.

COLEBUCKE MINES LIMITED [1949] (5)

Colebucke Mines Limited formerly held 6 claims south of Moose Lake along the South Wabi Creek in Firstbrook Township. The area is underlain by arkose of the Lorrain Formation, the diabase dike between the Portage Bay Sill, and the sill east of Moose Lake, and the red siltstones and argillite of the Firstbrook Member of the Gowganda Formation. A vertical diamond-drill hole south of Moose Lake intersected 920 feet of Firstbrook Member rocks.

A ground magnetometer survey was carried out and covered lot 1, concession I, and the northern half of concessions II and III as well as lot 2, concessions I, II, and III of Firstbrook Township. This survey delineated a magnetic anomaly which is believed to be the extension of the Nipissing Diabase dike

found south of George Lake connecting with the Nipissing Diabase sill south-southeast of Moose Lake (Assessment Files Research Office, Ontario Geological Survey, Toronto). The north-northwest-trending fault is also interpreted from the magnetic data.

HARMON OCCURRENCE (6)

Harmon Oils and Minerals Limited, held 12 claims in the southern half of lot 1, concessions IV, V, and VI, Firstbrook Township, south of George and Charlotte Lakes. The property is underlain by a porphyritic Nipissing Diabase dike, a band of Lorrain Formation arkose, and the Nipissing Diabase sill found north of Portage Bay.

In 1952, eight diamond-drill holes totalling 1789 feet in length were drilled in the Nipissing Diabase dike just south of Charlotte Lake. These holes intersected quartz and calcite veins averaging ¼ inch in width and quartz-carbonate veins up to 14 inches in width (Assessment Files Research Office, Ontario Geological Survey, Toronto). In one hole, disseminated cobaltite was encountered over a width of 4 inches of carbonate vein and wall rock. An average assay for the material was 0.5 ounce of silver per ton and 0.2 percent cobalt (Assessment Files Research Office, Ontario Geological Survey, Toronto).

LA PIERRE, A., OCCURRENCE (7)

Archie La Pierre formerly held 12 claims in Firstbrook and Coleman Townships south of Maggie Lake. These claims were optioned in 1971 by Copperfields Mining Corporation Limited and Pickle Crow Mines Limited who contracted Geophysical Engineering and Surveys Limited to undertake the geological and geophysical surveys. The property is underlain by a 0.5 km^2 inlier of Archean felsic tuffs, tuff breccias, massive flows, and conglomerate containing metavolcanic clasts which have been cut by lamprophyre dikes. Unconformably overlying the Archean rocks are Middle Precambrian sedimentary rocks. Clast-supported conglomerates of the Coleman Member of the Gowganda Formation occur in isolated patches over the metavolcanics. The grey argillite basal unit of the Firstbrook Member of the Gowganda Formation is found overlying both the "Coleman Conglomerate" and the metavolcanics. Both the Early and Middle Precambrian rocks have been cut by a porphyritic Nipissing Diabase dike.

Geological, magnetic, Radem VLF EM, SE-200 VEM, and self-potential surveys were carried out on lines spaced 200 feet apart. The geological survey undertaken recorded mineralization in the rhyolite, diabase, and Gowganda Formation sediments. In the rhyolite, 11 occurrences of finely disseminated chalcopyrite were found as local concentrations around the periphery of the inlier at the interface between the rhyolite and the grey argillite (Assessment Files Research Office, Ontario Geological Survey, Toronto). Local concentrations of chalcopyrite and bornite were found in and close to one of the lamprophyres, and selected samples contained an estimated 2 percent copper (Assess-

ment Files Research Office, Ontario Geological Survey, Toronto). The diabase contains less than 0.5 percent pyrite for a few metres away from its contact with the rhyolite. Minor blebs of chalcopyrite were found in the diabase close to the contact of the diabase with the metavolcanics (Assessment Files Research Office, Ontario Geological Survey, Toronto). Small pebbles of chalcopyrite and pebbles of chlorite partly replaced by chalcopyrite occur locally in the Coleman Member conglomerate (Assessment Files Research Office, Ontario Geological Survey, Toronto). In the Firstbrook Member argillites, grains of chalcopyrite less than 1 mm in size and conformable hairline stringers of chalcopyrite occur in the bedding planes. This mineralization never exceeds an estimated 0.5 percent copper over 24 inches (Assessment Files Research Office, Ontario Geological Survey, Toronto).

The geophysical work that was done over the property failed to outline significant anomalies (Assessment Files Research Office, Ontario Geological Survey, Toronto). A single diamond-drill hole of unknown length was drilled and intersected a 5-foot section of rhyolite containing disseminated galena (Geoscience Data Centre, Ontario Geological Survey, Toronto, File Wright, R.J., District of Timiskaming, Firstbrook Township).

MCKINNON MINE (8)

Norite Exploration Limited held 12 claims in the southern half of lot 1, concession V, and in lot 1, concession IV, Bucke Township. Colebucke Mines Limited held claims covering this area, and completed geological and magnetometer surveys and McKinnon Mines Limited in 1907 sunk a 152-foot shaft on this property. The last underground work is believed to have been done over 50 years ago. The ground is underlain by thickly laminated, red siltstones, shales, and lithic arenites of the Firstbrook Member. The sediments are cut by 2 diabase dikes of Keweenawan age: the Sharp Lake dike, and a narrower, similar dike associated with the Sharp Lake dike.

In 1963, detailed geological and magnetometer surveys were carried out, and were used to accurately locate the 2 Keweenawan diabase dikes. The "main dike" (Sharp Lake Diabase) varies in thickness from 59 feet to 119 feet and strikes northwest (Assessment Files Research Office, Ontario Geological Survey, Toronto). The other dike is younger and shows intrusive relationships with the Sharp Lake dike. It strikes west-northwest and varies in thickness from 30 feet to 76 feet (Assessment Files Research Office, Ontario Geological Survey, Toronto). The younger of the 2 dikes is epidotized, whereas the Sharp Lake dike is not.

In 1963, five diamond-drill holes totalling 3142 feet in length were drilled through the Sharp Lake sill. Sludge samples were taken from the drill holes and analyzed for silver every 10 feet. The lowest assay was 0.03 ounce of silver per ton over a width of 10 feet and the highest was a weighted average of 0.14 ounce of silver per ton over a width of 20 feet (Assessment Files Research Office, Ontario Geological Survey, Toronto). The weighted average assay for the sludge samples taken from all diamond-drill holes (Assessment Files Research Office, Ontario Geological Survey, Toronto) is 0.05 ounce of silver per ton. This

weighted average does not include trace or *nil* results from sludge samples.

Traces of pyrite and chalcopyrite were reported within the contact area of the diabase and sediments and occur in fractures parallel to the contact (Assessment Files Research Office, Ontario Geological Survey, Toronto). Cobaltite was reported in the dumps of the McKinnon Mine where it occurs as very fine disseminations in carbonate veins (Assessment Files Research Office, Ontario Geological Survey, Toronto). Assays of the vein material for silver were very low with the highest being 0.63 ounce of silver per ton (Assessment Files Research Office, Ontario Geological Survey, Toronto). The company has not filed further assessment work for this property.

OLD COLONY SECURITIES LIMITED [1960] (9)

Old Colony Securities Limited held claims in west-central Bucke Township which included 7 claims in the southwestern and southeastern quarters, southern half of lot 1, concession IV, and the northern half and northeastern quarter, south half of lot 1, concession III. The property is underlain by red, siltstones, wackes, and argillites of the Firstbrook Member of the Gowganda Formation which has been intruded by northwest-dipping Nipissing Diabase that outcrops in the southern part of the claims.

In 1960, a property report was submitted for assessment work describing the geology and recommending geochemical and geophysical exploration for silver; no subsequent work is on file (Assessment Files Research Office, Ontario Geological Survey, Toronto).

SAPPHIRE PETROLEUMS LIMITED (10)

Sapphire Petroleums Limited holds 6 leased claims, T31745 to T31749 inclusive and T31752 located in the southern half, lot 4, concession I, and the northeastern quarter and southeastern quarter of the southern half of lot 5, concession I, Firstbrook Township. These claims were formerly owned by Harmon Oils and Minerals Limited. The property is underlain by: a Nipissing porphyritic diabase dike south of George Lake; a band of Lorrain Formation feldspathic arenite; and the northern part of the Nipissing Diabase sill north of Portage Bay.

A geological survey was carried out in 1957 at a scale of 1 inch to 200 feet (1:2386). Many old trenches were reported on the property (Assessment Files Research Office, Ontario Geological Survey, Toronto).

SEED OCCURRENCE (11)

William Seed owns patented claim T 23473 in the southeastern quarter, northern half of lot 1, concession II, Bucke Township. A cobalt-bearing vein, with massive cobalt mineralization up to 3 inches in width has been reported

(Thomson 1964) on this claim. This was not found by the author.

SILVERBUCKE MINES LIMITED [1949] (12)

Silverbucke Mines Limited held underwater claims on Moose Lake in Firstbrook Township. Moose Lake is underlain by red siltstone, shales, and lithic arenites of the Firstbrook Member of the Gowganda Formation.

In 1948, a magnetometer survey was carried out on the claims with the object of tracing a bedrock valley containing "Keewatin Iron Formation which strikes northwest from the town of Cobalt". A reconnaissance survey failed to delineate such a structure within the claim group (Assessment Files Research Office, Ontario Geological Survey, Toronto).

WALTERS, L.E. [1948] (13)

Loyd E. Walters formerly held 8 unpatented claims in concession I, northern half of lots 7 and 8, Firstbrook Township, north of Maggie Lake. The claim group is underlain by red, interbedded siltstones and shales of the Firstbrook Member of the Gowganda Formation.

In 1948, a geological survey was conducted on north-south picket lines at a 300-foot interval. The purpose of the survey was to examine the property for cobalt-silver-bearing veins and fractures. No veins or fractures of any kind were found (Assessment Files Research Office, Ontario Geological Survey, Toronto).

Recommendations for Exploration

Innes and Colvine (1979) and Patterson (1979) have shed new light on the mineral potential of the Huronian sediments in the Cobalt Embayment. Patterson (1979) has listed 25 occurrences of base-metal mineralization in Coleman Member rocks within the Cobalt Mining Camp. Many of these occurrences, most previously unknown, appear to be controlled by paleovalleys in the Archean basement. The cobalt-silver mineralization is associated with quartz-carbonate veins that are found within the Nipissing Diabase, Early Precambrian metavolcanics, and the Coleman Member of the Gowganda Formation. The economically important quartz-carbonate veins are related to underlying, sulphide bearing, interflow sediments (Boyle and Dass 1971). Sulphide mineralization is associated with the 3 felsic metavolcanic centres that have been delineated within the Cobalt Camp (Patterson 1979). Economic silver- and cobalt-bearing veins can be expected to occur where diabase, metavolcanics, and Huronian sedimentary rocks exist together. John Wood (Chief Geologist, Ontario Geological Survey, personal communication, 1979) reported the occurrence of bornite in the dark grey, finely laminated Firstbrook Member of the Gowganda Formation outside the map area.

Exploration for silver and cobalt should be concentrated around the diabase-sediment contacts. Within the map area, the only diabase that has not undergone recent exploration is the sill between Pike and Le Moyne Lakes. Areas of special interest are south of Maggie Lake and northeast of Spring Lake where the three-fold relationship of Nipissing Diabase, Early Precambrian rocks, and Huronian sedimentary rocks exists.

Geophysical exploration should be carried out in order to attempt to delineate paleovalleys in the underlying Archean basement. Based on the paleovalley hypothesis at Cobalt, a possibility would exist for base-metal mineralization in the Coleman Member sedimentary rocks therein. The felsic metavolcanic inlier south of Maggie Lake has potential for volcanogenic base-metal mineralization, but its small exposure and underlying topography will make prospecting difficult.

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PAGE

Agnico-Eagle Mines Ltd. 4, 35, 36, 37, 40, 41, 43
Analyses, chemical 7
  Felsic metavolcanic tuff; table 10
  Keweenawan Diabase dike; table . . 31
  Nipissing Diabase sills; table 29
    Location of samples; table 30
See also: Assays.
Andalusite 21
Archean felsic metavolcanic inlier 7, 15, 36
Argillite 11, 17
Armstrong, J.E. 36, 37
Arsenic; assay 44
Assays:
  Arsenic 44
  Cobalt 37, 39, 44, 47
  Copper 39, 47
  Gold 36, 45
  Nickel 44
  Silver 37, 39, 44, 47-49
  Vein material; table 38

Bartle Lake 32
Basalts, tholeiitic 32
Bed thickness:
  Argillite in Gowganda Formation . . 17
  Wacke in Lorrain Formation 22
Bismuth 39
  Native 44
Blanche Lake 13
Bornite 39, 50
Brecciated shears 35

Cabol Enterprises Ltd. 37
Canadian Cobalt and Metals Co. Ltd. . 45
Canadian Prospect Property . . 35, 36, 41
See also: Cobalt-Kittson Mine.
Chalcocite 40, 46
Chalcopyrite 7, 39, 40, 46, 48, 49
Charlotte Lake 4, 39, 47
Chemical analyses 7
  Felsic metavolcanic tuff; table 10
  Keweenawan Diabase dikes; table . 31
  Nipissing Diabase sills; table 29
    Location of samples; table 30
See also: Assays.
Chitaroni, Albert 37, 39
Chitaroni, Carl 37
Chitaroni, Elio 37
Chlorite spotting 20, 23
Claim group, Walters 4
Claim holders, patented; table 37
Clasts:
  In conglomerate 14, 15
  In pebbly wacke 12, 13
Cobalt 37, 39, 43, 51
  Assays 37, 39, 44, 47

PAGE

  Bloom 39, 46
  Mineralization 49
  Ore 44
Cobalt Consolidated Mining Corp. Ltd. . 43
Cobalt Embayment 4, 33
  Mineral potential 50
Cobaltite 37, 44, 49
Cobalt-Kittson Mine 4, 35, 36, 45
See also: Canadian Prospect Property.
Cobalt-Kittson Mines Ltd. 45
Cobalt Products Ltd. 43
Cobalt-silver mineralization 50
Cobalt Series 43
Colebucke Mines Ltd. 4, 41, 48
Coleman Tp., Corp. of 37
Conglomerate 7
  Clast-supported 14, 15
  Matrix-supported 15
Contacts:
  Firstbrook Member (Gowganda Formation) - Lorrain Formation 19, 21, 22
  Nipissing Diabase dike - Lorrain Formation 39
  Nipissing Diabase sill - Sharp Lake diabase dike 39
Copper; assays 39, 47
Copperfields Mining Corp. Ltd. . 4, 36, 47
Cross Lake Fault 15, 34
Crystal tuff 7
Cummings, Barbara 37

Deformation, soft-sediment 13
Delta, ice contact 32
Diabase:
  Chilled 27
  Dikes 30
    Keweenawan 30
      Chemical analyses; table 31
      Epidotized 46
    Nipissing 45, 46
      Contact with Lorrain Formation 39
    Sharp Lake 35, 39
      Contact with Nipissing Diabase Sill 39
  Porphyritic 28
  Sills:
    Nipissing 47, 49
      Thickness 27
  Texture, varied 28
Dikes:
  Diabase:
    Keweenawan 30
      Chemical analyses; table 31
      Epidotized 46
    Nipissing 45, 46

PAGE

Contact with Lorrain Formation 39
Sharp Lake 30, 35, 39, 46
Contact with Nipissing Diabase sill 39
Lamprophyre 7, 40, 47
Dotsee Cobalt Mines 43
Dotsee Mine . . . 4, 11, 35-37, 41, 43, 44
Vein 44
See also: Seed Mine.
Dropstones 13

Emplectite 44

Faults 19
Cross Lake 15, 34
Latchford 22, 34
Firstbrook Member (Gowganda Formation) - Lorrain Formation contact 19, 21, 22
Flows, massive felsic 7
Floyd Silver Mines 43
Fold Belt, Penokean 33
Folds, slump 34

Galena 40, 48
Geophysical Engineering & Surveys Ltd. 47
George Lake 4, 28, 32, 47, 49
Glacial fluting 32
Glaciolacustrine plain 32
Gold 45
Assays 36, 45

Harmon Oils and Minerals Ltd. . 4, 47, 49
Harmon Occurrence 41
Hazelton-Porcupine Gold Mines Ltd. . 45
Humboldt, Janette H. 37

Inlier, Archean felsic metavolcanic 7, 15, 36

Jacksic, Joseph 37
Johnson, Herbert 36

Keweenawan Diabase dikes 30
Chemical analyses; table 31
Epidotized 46
Kitt Creek 4, 22, 35, 36, 45
Kittson-Hazelton Gold Mines Ltd. . . . 45

Laminae in argillite 13, 17
Lamprophyre dikes 7, 40, 47
La Pierre, Archie 47
La Pierre Occurrence 41
Lapilli-tuff 6
Latchford (town) 45
Latchford Fault 22, 34
Le Moyne Lake 13, 14, 15, 51
Lithologic units; table 5

PAGE

Little Clay Belt 33
Loon Lake 32
Lorrain Formation contacts:
Firstbrook Member (Gowganda Formation) 19, 21, 22
Nipissing Diabase dike 39
McCready, W.E. 43, 44
McKinnon Mine 35, 39, 41
McKinnon Mines Ltd. 4, 48
McLaren Lake 23
McLennon Lake 20, 35
Maggie Lake 4, 6, 7, 15, 36, 39, 47, 50, 51
Malcolm Lake 11, 23, 35
Mattawapika Dam 17
Metasediments:
Early Precambrian 6
Timiskaming type 7
Metavolcanics:
Early Precambrian 6
Mineralization, cobalt-silver 50
Mineral potential of Cobalt Embayment 50
Montreal River 15, 17, 19, 34, 35, 45
Moose Lake 4, 19, 20, 27, 28, 34, 35, 46, 50
Moraine:
Hummocky 32
Sandy ground 32
Mowat Lake 30
Mowat Landing 15

Nickel 43
Assay 44
Nipissing Diabase 43
Dikes 45, 46
Contact with Lorrain Formation . 39
Sills 27, 47, 49
Chemical analyses; table 29
Location of samples; table . . 30
Contact with Sharp Lake diabase dike 39
Thickness 27
Norite Explorations Ltd. 4, 48
Norite Mines Ltd. 39

Old Colony Securities Ltd. 4, 41, 49

Peat 33
Penokean Fold Belt 33
Pickle Crow Explorations Ltd. 4, 36
Pickle Crow Mines Ltd. 47
Pike Creek 35
Pike Lake 17, 32, 35, 51
Porphyritic diabase 28
Portage Bay . . . 16, 22, 28, 39, 46, 47, 49
Price, Gerald 37
Price, Noreen 37
Properties:
Assessment files information; table 41

PAGE

Pyrite 7, 39, 40, 46, 48, 49

Quartz:
  Sheets 35
  Veins 39

Red Pine Point 17, 32
Reid Lake 32
Rift Valley, Lake Timiskaming 39

St. Joseph Exploration Ltd. 36
Sandstone 20
Sapphire Petroleums Ltd. 4, 41
Sedimentary structures 18, 20, 22
Sedimentary environment 25
Sediments, Middle Precambrian
    Huronian 4
Seed, William E. 37, 43, 49
Seed Occurrence (Mine) 41, 43
See also: Dotsee Mine.
Sharp Lake 30
Sharp Lake diabase dikes 4, 30, 35, 39, 46
  Contact with Nipissing Diabase sill . 39
Shears, brecciated 35
Shepherd, James H., Estate 37
Silanco Mining & Refining Co. Ltd. . . . 43
Sills 16, 51
  Nipissing Diabase 27, 47, 49
    Chemical analyses; table 29
      Location of samples; table . . 30
    Contact with Sharp Lake diabase dike 39
    Thickness 27
Silver 3, 35, 37, 43, 51
  Assays 37, 39, 44, 47-49
Silverbucke Mines Ltd. 41, 50
Silver-cobalt mineralization discovery . 35
Silverfield Mine 40
Slump folds 34
Smaltite 39, 45
South Wabi Creek 46

PAGE

Sphalerite 40
Spring Lake 15, 32, 51
Sulphide minerals.
See: Chalcopyrite; Galena; Pyrite; Sphalerite.
Syncline 34

Textures:
  "marble cake" 16
  Varied 28
  Wormy 13
Thickness:
  Coleman Member 11
  Firstbrook Member 11
  Nipissing Diabase sills 27
Tholeiitic basalts 32
Thomson, Robert 39
Till, lodgement 15
Tillites 25
Timiskaming Rift Valley, Lake 34
Todd, E.H. 43
Tormont Mines Ltd. 37
Tuff:
  Crystal 7
  Felsic 7
Tuff-breccia 7

Unconformity 4

Veins:
  Assay; table 38
  Cobalt-bearing 49
  Quartz 39

Wackes 22
  Pebbly 11, 13
    Clasts *in* 12, 13
Walters, L.E. 41, 50
Walters claim group 4
Watts, Murray 43

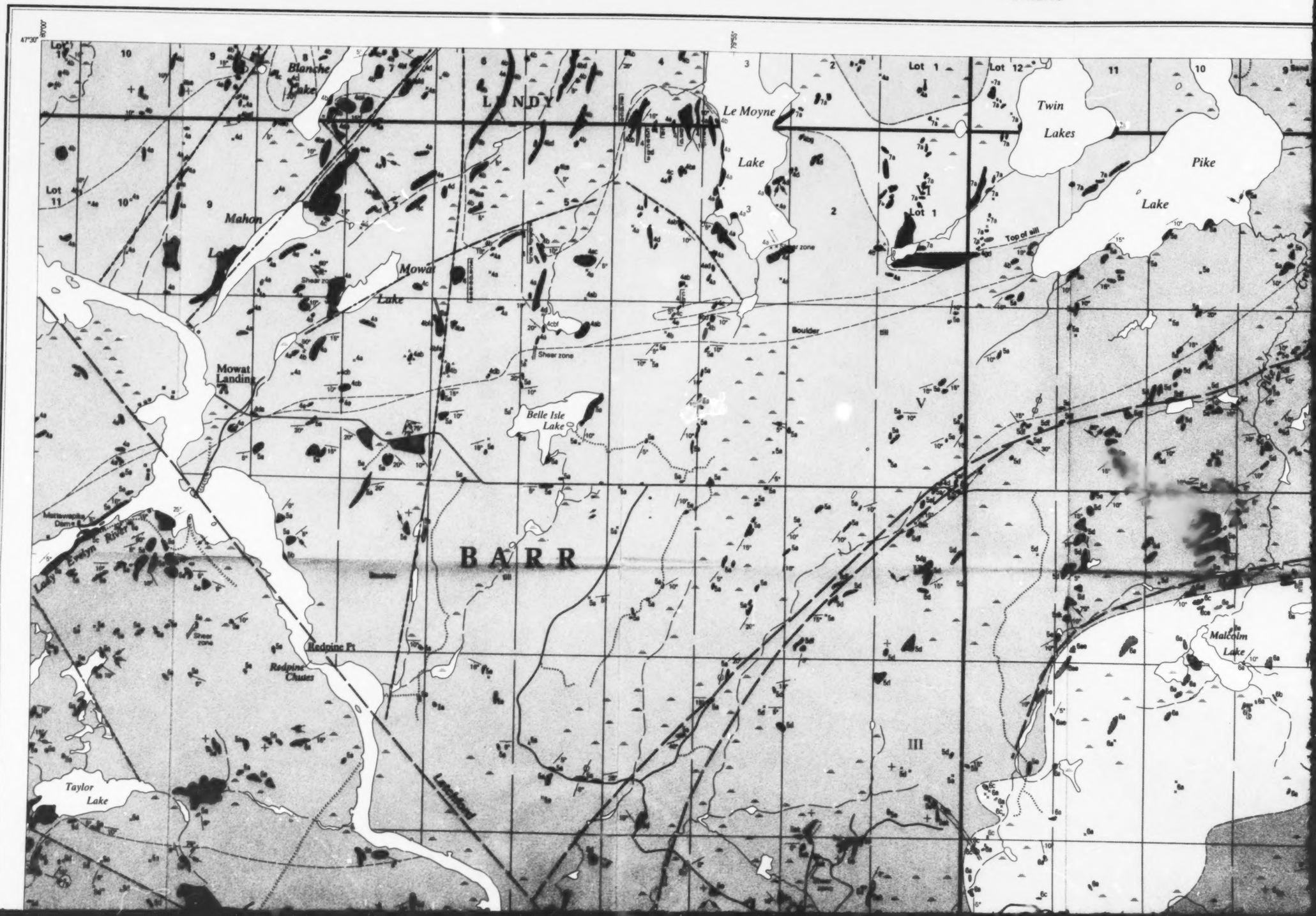
Yorkshire Cobalt Mining Co. 43

Ministry of Natural Resources

Ontario

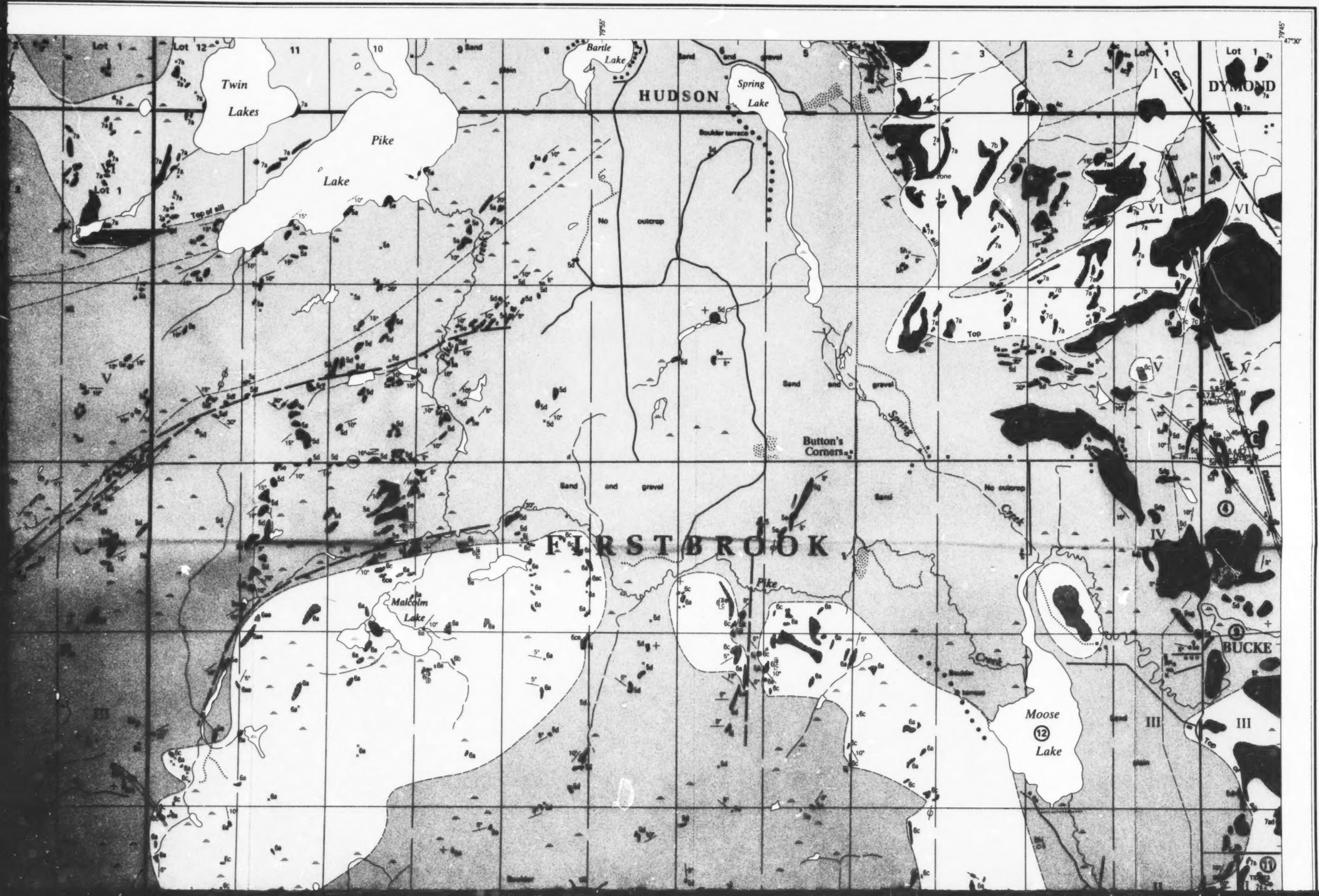
SYMBOLS

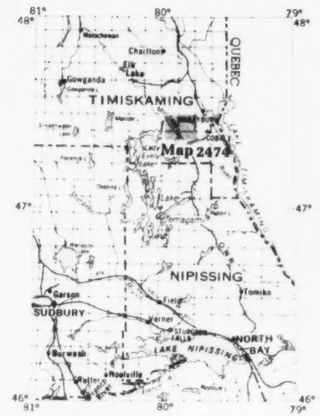
- Glacial striae.
- Outwash fan.
- Hummocky topography.
- Esker.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, horizontal.
- Bedding, top unknown; (inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- DH — Drill hole, (vertical, inclined).
- 64m — Shaft
- Gravel pit.
- Swamp.
- 558 — Motor road. Provincial highway number encircled where applicable.
- Other road.
- Trail, portage, winter road.
- Building.
- Township boundary, with milepost; approximate position only.
- 12 — Mining property, surveyed; approximate position only.
- 3 — Mineral occurrence; mining property, unsurveyed.
- Surveyed line; approximate position only.



Ministry of Natural Resources
Ontario

Ontario Geological Survey
Map 2474
Firstbrook and Parts of
Surrounding Townships





Scale 1 inch to 50 miles
NTS Reference 31 M/5

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Glacial, glacialfluvial, swamp, lake and stream deposits.

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

8a Diabase.
8b Epidotized diabase.
8c Granophyric diabase.

INTRUSIVE CONTACT

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

NIPISSING DIABASE

7a Quartz diabase.
7b Granophyric diabase.
7c Granophyre.
7d Varied textured diabase.
7e Diabase chilled margins.
7f Porphyritic diabase.

INTRUSIVE CONTACT

HURONIAN SUPERGROUP

COBALT GROUP

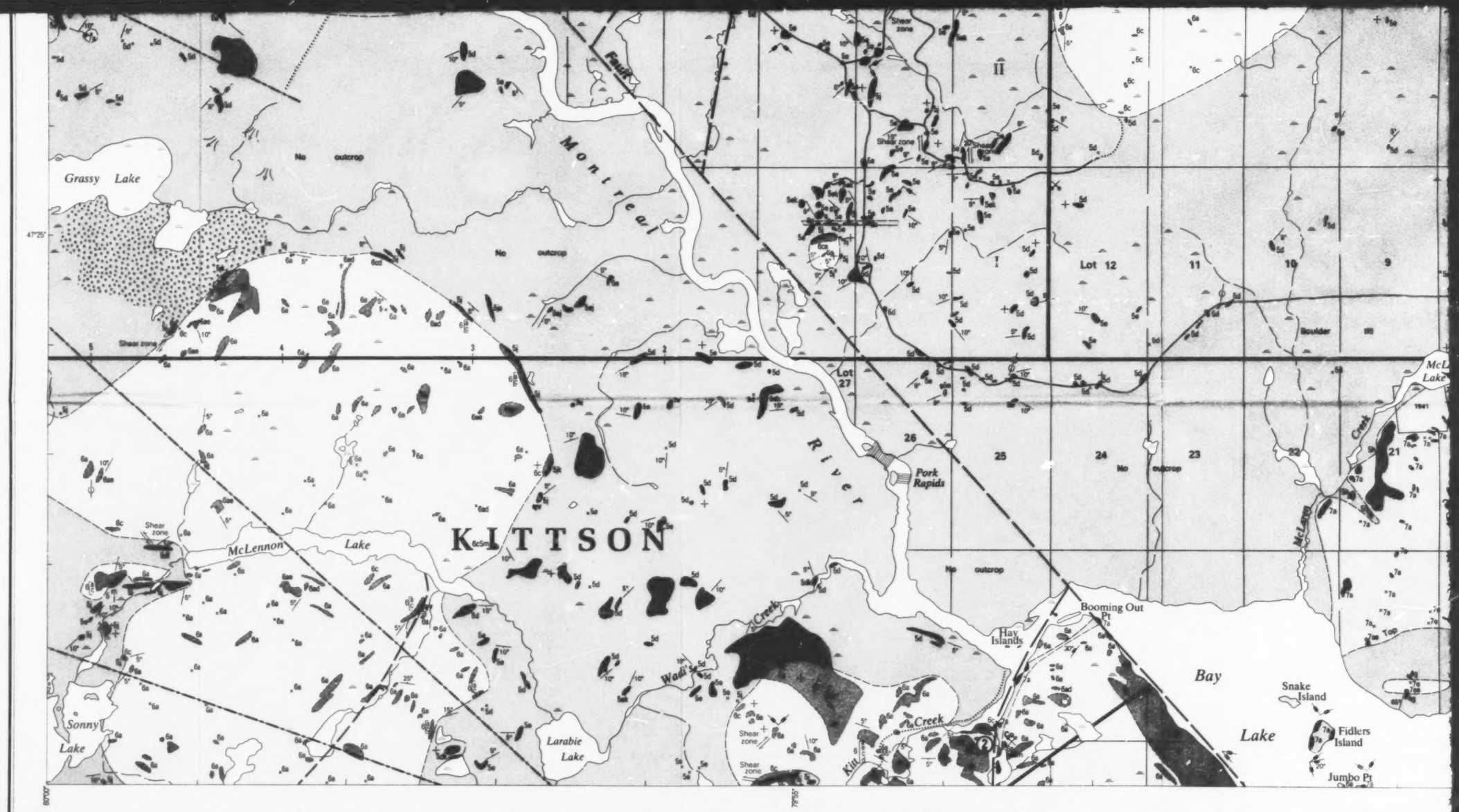
LORRAIN FORMATION

6 Unsubdivided.
6a Arkose.
6b Quartz arenite.
6c Basal maroon wacke.
6d Cross beds, ripple marks.
6e Ball and pillow structure.
6f Contact metamorphosed rocks.

CONFORMABLE CONTACT

GOWGANDA FORMATION

Firstbrook Member[c]



Published 1984

PROPERTIES, MINERAL DEPOSITS

1. Agnico-Eagle Mines Ltd. (Dotsee Mine).
2. Canadian Prospect.
3. Colebucke Mines Ltd. [1948].
4. Colebucke Mines Ltd. [1948].
5. Colebucke Mines Ltd. [1949].
6. Harmon Occurrence.
7. La Pierre, A. Occurrence.
8. McKinnon Mine.
9. Old Colony Securities Ltd. [1960].
10. Sapphire Petroleums Ltd.
11. Seed Occurrence.
12. Silverbucke Mines Ltd. [1949].
13. Walters L. E. [1948].

Information current to December 31, 1979.

Former properties on ground now open for staking are only shown where exploration information is available. A date in square brackets indicates last year of exploration activity. For further information see report.

SOURCES OF INFORMATION

Geology by G. W. Johns, R. Van Steenburgh and assistants, Ontario Geological Survey, 1979. Geology is not tied to surveyed lines.

Assessment files, Research Office, Ontario Geological Survey, Toronto.

Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake.

Geological Survey of Canada. Aeromagnetic map 1492G, Cobalt.

Ontario Department of Mines
Map 1956a, Township of Bucke, scale 1" to ¼ mile, 1956.
Map 2300, Kerns and Hudson Townships, scale 1" to ½ mile, 1970.
Map 2301, Harley and Dymond Townships, scale 1" to ½ mile, 1970.

Preliminary Maps (OGS)
P.2279, Firstbrook Lake Area, 1" to ¼ mile, 1979.

Cartography by T. Wade and assistants, Surveys and Mapping Branch, 1984

Basemap derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by G. W. Johns.

Magnetic declination in the area was approximately 11° west, 1979.

Parts of this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Johns G. W. and Van Steenburgh R.
1984: Firstbrook and Parts of Surrounding Townships; Ontario Geological Survey Map 2474, Precambrian Geology Series, Scale 1" to ½ mile, Geology 1979.

Ontario Geological Survey

Map 2474

FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS

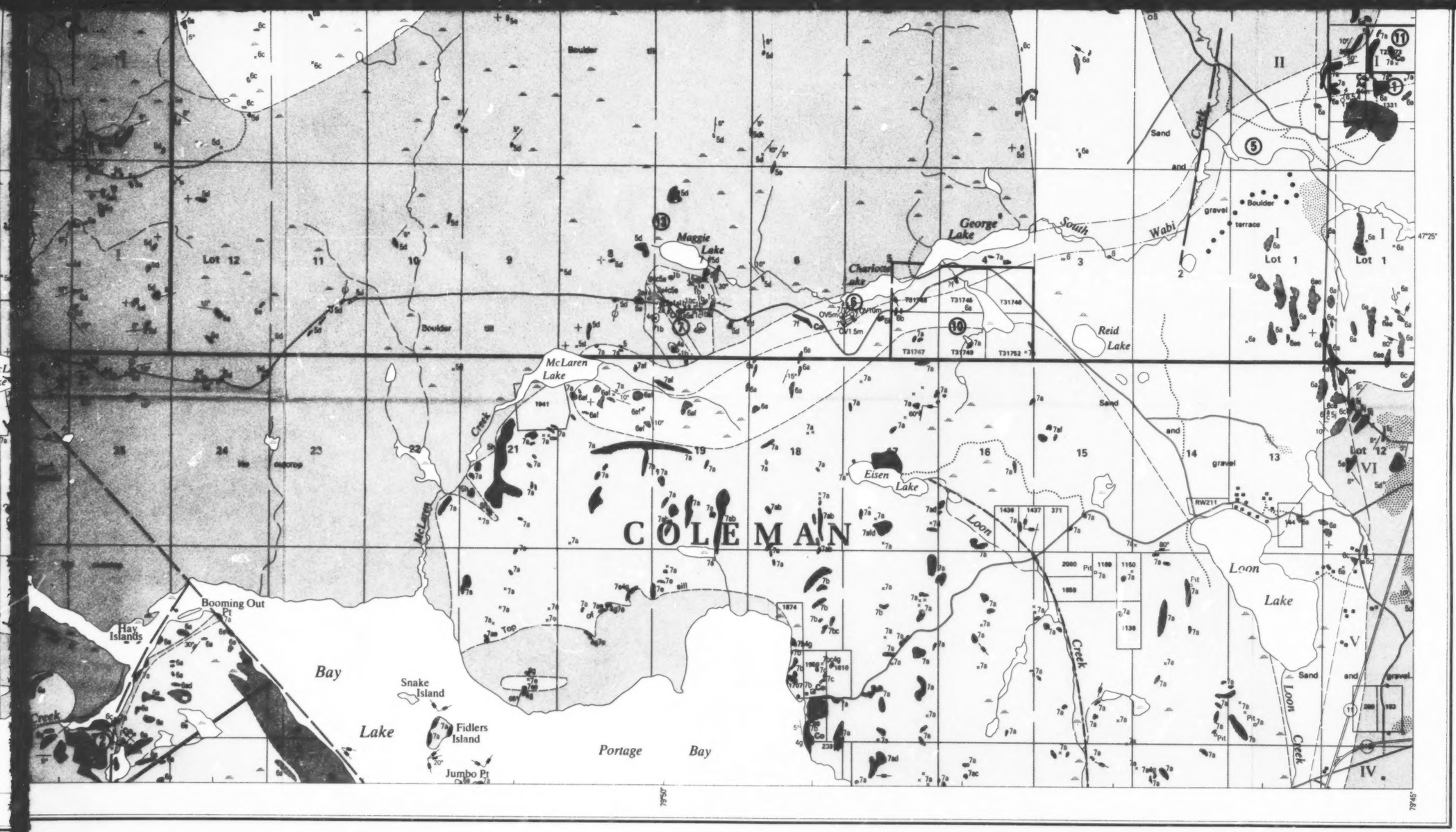
TIMISKAMING DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1

Metres 1000 0 1 2 3 Kilometres

Feet 1000 0 5,000 10,000 Feet



Ontario Geological Survey

Map 2474

FIRSTBROOK AND PARTS OF SURROUNDING TOWNSHIPS

TIMISKAMING DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

60 40 20 0 1 2 Miles

1000 0 1 2 3 Kilometres

Feet 1000 0 5,000 10,000 Feet

6f *Contact metamorphosed rocks.*

CONFORMABLE CONTACT

GOWGANDA FORMATION

Firstbrook Member[c]

5 *Unsubdivided.*
5n *Red, thin bedded wackes and siltstones showing contact metamorphism.*
5m *Red, thin bedded wackes and siltstones brecciated.*
5k *Thickly laminated, red siltstone, shale chloritic siltstone and red thin bedded wackes and siltstones with ripple marks, cross beds and graded beds.*
5j *Red, thin bedded wackes and siltstones.*
5h *Thickly laminated, red siltstone, shale chloritic siltstone showing contact metamorphism.*
5g *Thickly laminated, red siltstone, shale, chloritic siltstone showing soft sediment deformation.*
5f *Thinnly laminated, black to grey shaley argillite and thickly laminated, red siltstone, shale, chloritic siltstone tectonically deformed.*
5e *Thickly laminated, red siltstone, shale, chloritic siltstone with increasing sand component.*
5d *Thickly laminated, red siltstone, shale, chloritic siltstone.*
5c *Thinnly laminated, black to grey shaley argillite, with ball and pillow structures.*
5b *Thinnly laminated, black to grey shaley argillite, showing soft sediment deformation.*
5a *Thinnly laminated, black to grey shaley argillite.*

CONFORMABLE CONTACT

Coleman Member

4a *Pebbly wacke.*
4b *Argillite.*
4c *Conglomerate.*
4d *Wacke.*
4e *Arkose.*
4f *Dropstones.*
4g *Contact metamorphosed sediments.*

UNCONFORMITY

EARLY PRECAMBRIAN (ARCHEAN)

MAFIC INTRUSIVE ROCKS

3a *Lamprophyre.*

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS

METASEDIMENTS

2 *Unsubdivided.*
2a *Conglomerate (Timiskaming type).*

METAVOLCANICS

FELSIC METAVOLCANICS

1a *Massive flows, Hornblende porphyry.*
1b *Tuffs, lapilli tuffs.*
1c *Tuff breccia.*

Breccia

Ag *Silver*
Co *Cobalt*
Cu *Copper*
qv *Quartz vein*

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each map rock unit are shown respectively in deep and light tones of the same colour. Where in places a formation is too narrow to show in colour and must appear in black, a short black bar appears in the appropriate block.*

[c] *The general stratigraphic succession, from the base upwards, in the Firstbrook Member is thinnly laminated grey to black argillites (5a), succeeded in turn by red, thickly laminated siltstone and arenite (5d), and red, thin bedded wacke and siltstone (5j).*

[d] *The Coleman Member consists of complexly interrelated lithologic units. Where stratigraphic succession is observed the outcrop is coded thus* 4[b/a]